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PROCEEDINGS

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ARTS AND SCIENCES.

VOL. X.

PAPERS READ BEFORE THE ACADEMY.

I.

RESEARCHES ON THE HEXATOMIC COMPOUNDS OF COBALT.*

BY WOLCOTT GIBBS, M.D.

Presented, Oct. 13, 1874.

IN the joint memoir of Genth and myself on the ammonia-cobalt bases it was stated that xanthocobalt is not the only product of the action of nitrous acid gas upon ammoniacal solutions of cobalt. A further investigation of this and other related subjects was then promised. I propose now to resume the study of this class of compounds from the standpoint of the chemistry of the present day. The progress of science has rendered necessary the abandonment of my former theoretical views, as well as the adoption of the new notation. It has also, as I shall endeavor to show, lent a peculiar interest to the study of the ammonia-metallic bases.

In studying the action of the alkaline nitrites upon salts of cobalt, or upon those of the different series of ammonia-cobalt compounds, a principal difficulty arises from the varying nature and relative proportions of the products obtained under various conditions of temperature, concentration of solutions employed, and duration of action. I have endeavored to cover the whole ground as completely as possible.

1. *Action of Ammonia and Ammonic Nitrite upon a Solution of Cobaltic Chloride and Ammonic Nitrate.* — When a warm solution of

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* Being Part II. of Researches on the Ammonia-cobalt Bases, by Wolcott Gibbs and F. A. Genth.

cobaltic chloride, $CoCl_2$, is mixed with ammonic nitrate, and then with a solution of ammonic nitrite, containing much free ammonia, the solution soon becomes deep orange, and after twenty-four hours deposits orange-brown crystals in large quantity. The mother liquor of these crystals is olive-green. By re-solution in hot water containing a few drops of acetic acid, and filtration, beautiful orange-yellow needles may be obtained as this filtrate cools. The crystals are perfectly free from chlorine, and represent the nitrate of a new series of ammonia-cobalt salts, the formula of the salts being

$$Co_2(NH_3)_8(NO_2)_4(NO_3)_2.$$

The formation of this salt is accompanied by an absorption of oxygen from the air, and may be expressed by the equation: —

$$2CoCl_2 + 2NH_4.NO_3 + 8NH_3 + 4NH_4.NO_2 + O = \\ Co_2(NH_3)_8(NO_2)_4(NO_3)_2 + 4NH_4Cl + 2(NH_4)_2O.$$

2. *Action of a Mixture of Ammonia and Potassic Nitrite upon Cobaltic Sulphate.* — When cobaltic sulphate is dissolved in water and a mixture of ammonia and potassic nitrite is added, the liquid speedily becomes brown upon the surface, and after a few hours orange-yellow crystals form upon the bottom and sides of the containing vessel, while a green flocky matter is at the same time deposited. When large quantities of material are operated upon, the complete oxidation requires several days. On filtering, a bright green mass mixed with orange-yellow crystals remains upon the filter: the filtrate is olive-green, and after standing often deposits small, brilliant orange-yellow scales. If the mass on the filter is treated with hot very dilute sulphuric acid, it instantly becomes bright orange, and by boiling dissolves. The filtered solution then deposits, on cooling, a splendid salt, which has the formula

$$Co_2(NH_3)_8(NO_2)_4SO_4,$$

and which is the sulphate corresponding to the nitrate already mentioned.

3. *Action of a Mixture of Ammonia and Potassic Nitrite upon Cobaltic Nitrate.* — When cobaltic nitrate is dissolved in water and a mixture of ammonia and potassic nitrite is added, the liquid speedily becomes brownish-orange, and after an hour begins to deposit bright orange-yellow crystals, mixed with a green flocky matter, precisely as in the case of the sulphate. By dissolving the orange-yellow crystals in boiling water, a few drops of acetic acid being added to prevent decomposition, a fine sherry-wine-colored solution is obtained, which, on cooling, deposits crystals of two different forms, the larger portion being in octahedrons, the smaller in prismatic forms. By careful mechanical

separation and recrystallization, these crystals may be separated and the two salts obtained pure for analysis. In this manner I found the octahedral salt to be nitrate of xanthocobalt, while the prismatic crystals are the nitrate of the octamin series above mentioned. In one experiment, of the octahedral salt,

0·3833 gr. gave 0·1890 gr. $CoSO_4 = 18·77$ per cent cobalt.

The formula of nitrate of xanthocobalt, $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4$, requires 18·73 per cent. Of the prismatic salt,

0·7369 gr. gave 0·4050 gr. $CoSo_4 = 20·92$ per cent cobalt.

The formula of the nitrate of the new series,

$Co_2(NH_3)_8(NO_2)_4(NO_3)_2$, requires 20·99 per cent.

For greater certainty I made also a nitrogen determination in this nitrate:—

0·5668 gr. gave 168·5 c.c. nitrogen at 13·5° C. and $756·1^{mm} =$ 34·79 per cent nitrogen.

The formula cited requires 34·88 per cent. The two salts were further readily recognized by their characteristic reactions. In my experiments the proportion of xanthocobalt salt formed was much the greater. The formation of the new nitrate may in this case be represented by the equation:—

$$2Co(NO_3)_2 + 8NH_3 + 4KNO_2 + OH_2 + O = Co_2(NH_3)_8(NO_2)_4(NO_3)_2 + 2KNO_3 + 2OKH;$$

and the formation of the nitrate of xanthocobalt by the equation:—

$$2Co(NO_3)_2 + 10NH_3 + 2KNO_2 + OH_2 + O = Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 + 2OKH.$$

The green flocky matter which accompanies the formation of the above-mentioned nitrates and sulphate is cobaltic hydrate, $Co(OH)_2 + 2OH_2$. and is of course due to the action of the potassic hydrate upon the solution of cobalt in excess. I varied the above process by adding ammonia first to the solution of cobaltic nitrate, and afterward the solution of potassic nitrite, but the results were the same.

4. *Action of Ammonia and Potassic Nitrite upon a Mixture of Cobaltic and Ammonic Sulphates.* — In this case as in the others the solution becomes brown and deposits an orange crystalline mass. If the mass is dissolved in water and a solution of potassic bromide is added, after standing, fine crystals are formed, which, after a single recrystallization, are pure bromide of xanthocobalt. In one experiment:—

0·5634 gr. gave 0·2496 gr. $CoSO_4 = 16·87$ per cent cobalt.

0·7294 gr. gave 0·4496 gr. silver $= 45·65$ per cent bromine.

The formula, $Co_2(NH_3)_{10}(NO_2)_2Br_4$, requires cobalt 16·86, bromine 45·71. I did not succeed in finding the sulphate of the octamin series among the products in the single experiment which I made with the above-mentioned mixture. If present at all, its relative quantity must have been small. The formation of sulphate of xanthocobalt is easily explained by the equation: —

$$2CoSO_4 + 10NH_3 + 2KNO_2 + OH_2 + O = \\ Co_2(NH_3)_{10}(NO_2)_2(SO_4)_2 + 2OKH;$$

but it is not easy to see why the presence of ammonic sulphate should determine the production of sulphate of xanthocobalt in place of the sulphate of the octamin series.

With these preliminaries I pass to the description of the salts of the new octamin series. These salts as a class greatly resemble those of xanthocobalt, but are rather more stable. They have a fine sherry-wine color, are usually comparatively insoluble in cold, and are dissolved with difficulty even by boiling water. The solutions when neutral are decomposed by boiling, ammonia being evolved and a black powder precipitated. The addition of a small quantity of acetic acid serves to prevent the decomposition in hot solutions. Mineral acids, even in small quantity, usually produce more or less decomposition on heating. The salts crystallize with remarkable facility, resembling in this respect the salts of luteocobalt, which are, however, much more soluble. As the octamin salts are easily prepared in quantity, they may hereafter be found to possess some value as means of investigation from their remarkable power of crystallization.

Sulphate. — Of all the salts of this series the sulphate is that which is most easily prepared in quantity and free from other products. The general method of preparation has been already pointed out. The mixture of cobaltic hydrate and crude sulphate is to be boiled with very dilute sulphuric acid, filtered, and the solution allowed to stand for a few hours, when the sulphate separates almost completely, in consequence of its insolubility in cold water. The mother liquor contains a large quantity of cobaltic sulphate, and traces of the new salt together with potassic and ammonic sulphates. A second crystallization gives a perfectly pure salt. In large crystals the salt has a dark wine-red color, like the salts of xanthocobalt. It usually separates from hot concentrated solutions in small, very brilliant yellow scales, which, under the microscope, appear to belong to the quadratic system. The sulphate is remarkable for its insolubility. Cold water dissolves a very small quantity, the solution taking a golden-yellow color. Even in

boiling water the salt is but slightly soluble; but dilute sulphuric acid dissolves it more readily and without decomposition, if the boiling be not continued too long. Stronger acid readily decomposes the sulphate by boiling. When boiled for some time with dilute chlorhydric acid, the solution gradually becomes violet-red, and on cooling deposits crystals of chloride of purpureocobalt. Of these crystals,

0·2825 gr. gave 0·1749 gr. $CoSO_4 = 23·56$ per cent cobalt.

The formula $Co_2(NH_3)_{10}Cl_6$ requires 23·55 per cent.

The decomposition is accompanied by effervescence from the escape of gas, apparently nitrogen mixed with a smaller quantity of nitrous acid vapors, and may perhaps be expressed by the equation: —

$$2Co_2(NH_3)_8(NO_2)_4SO_4 + 6HCl = Co_2(NH_3)_{10}Cl_6 + 2CoSO_4 + 12OH_2 + 2NO_2 + 12N.$$

In this reaction we pass from a lower to a higher ammonia-base, and Genth and I have shown that we may also pass from purpureocobalt to luteocobalt, or from the decamin to the dodecamin series, the higher term being in each case the product of the decomposition of the lower The formula of the sulphate in the new series is, as stated, $Co_2(NH_3)_8(NO_2)_4SO_4$. The following are the direct results of analysis: —

0·6142 gr. gave 0·3596 gr. $CoSO_4 = 22·28$ per cent cobalt.
0·4207 gr. gave 0·2454 gr. " = 22·21 " "
1·5547 gr. gave 0·6785 gr. $BaSo_4 = 17·98$ " SO_4
0·6960 gr. gave 0·2903 gr. water = 4·63 " hydrogen.
0·4693 gr. gave 123·5 c.c. nitrogen at 9·5° C. and $754·5^{mm} = 31·33$ per cent.

			Calculated.	Found.	
Cobalt	2	118	22·09	22·28	22·21
SO_4	1	96	17·97	17·98	
Hydrogen	24	24	4·49	4·63	
Nitrogen	12	168	31·46	31·33	
Oxygen	8	128	23·99		
		534	100·00		

On Blomstrand's view of the constitution of the ammonia-metallic bases, the formula of the sulphate may be written: —

$$\overset{vi}{Co_2}\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NH_3 \\ NH_3-NH_3 \\ NH_3-NO_2 \\ NH_3-NO_2 \end{array}\right. \begin{array}{l} \\ \\ >SO_4 \\ \\ \\ \end{array}$$

I shall discuss this view more fully at the close of this paper.

Chloride. — The chloride of this series cannot be readily obtained by the action of a mixture of ammonia and potassic nitrite upon cobaltic chloride, since, as I shall show hereafter, other products are formed under these circumstances in much the larger quantities, salts of xanthocobalt predominating. It may, however, be easily prepared in quantity by boiling the crude sulphate with baric chloride and a very small quantity of chlorhydric acid. To avoid loss, the baric sulphate must be repeatedly and carefully washed with boiling water and a trace of free acid. The chloride then crystallizes from the filtrate in beautiful iridescent crystals. The forms of these crystals, together with those of other salts of this series, I hope hereafter to be able to give in detail. The chloride has the characteristic sherry-wine color of the salts of this series, and the small crystals are very brilliant and exhibit a remarkable iridescence.

The chloride is more soluble than the sulphate, but still belongs to the class of slightly soluble salts, and crystallizes almost completely from hot solutions as these become cold. The salt possesses in a high degree the sharply defined crystalline character of the members of this series, and forms a large number of compounds with metallic chlorides, many of which are of great beauty. The constitution of the chloride is represented by the formula

$$Co_2(NH_3)_8(NO_2)_4Cl_2,$$

as the following analyses show: —

0·5164 gr. gave 0.3152 gr. $CoSO_4 = 23·24$ per cent cobalt.
0·6048 gr. gave 0·3683 gr. $CoSO_4 = 23·18$ " "
0·7188 gr. gave 0·3027 gr. silver $= 13·84$ " chlorine.
0·4846 gr. gave 0·2152 gr. water $= 4·92$ " hydrogen.
0·6160 gr. gave 172·5 c.c. nitrogen at 16° C. and $768·2^{mm} =$ 32·91 per cent.

			Calculated.	Found.
Cobalt	2	118	23·18	23·18 23.24
Chlorine	2	71	13·94	13·84
Hydrogen	24	24	4·71	4·90
Nitrogen	12	168	33·00	32·91
Oxygen	8	128	25·17	
		509	100·00	

The corresponding bromide, $Co_2(NH_3)_8(NO_2)_4Br_2$, resembles the chloride so closely that no special description is necessary. In this salt,

0·3944 gr. gave 0·2059 gr. $CoSO_4 = 19·87$.

The formula requires 19·73 per cent.

Hyperiodide. — When a solution of iodine in potassic iodide is added to one of the nitrate of this series, a magnificent crystalline cinnabar-red compound is precipitated, which may be washed with cold water, and afterward with a little alcohol, without decomposition. For analysis, the salt was dried in pleno over sulphuric acid. The crystals are small scales of unusual beauty and richness of color. They are slightly soluble in cold water, and are partially decomposed by boiling water with evolution of iodine vapors. Even long boiling, however, does not appear to decompose them completely. When heated with a solution of sodic sulphite, the salt instantly becomes yellow and is converted into the normal iodide. No similar compound is formed when a solution of potassic hyperiodide is added to one of nitrate of xanthocobalt. The formation of the hyperiodide may be represented by the equation:

$$Co_2(NH_3)_8(NO_2)_4(NO_3)_2 + 2KI_3 = Co_2(NH_3)_8(NO_2)_4I_6 + 2KNO_3.$$

In this salt,

0·5748 gr. gave 0·1494 gr. $CoSO_4$ = 9·87 per cent cobalt.
0·4705 gr. gave 0·2550 gr. silver = 63·70 „ iodine.
0·3942 gr. gave 49 c.c. nitrogen at 14·5° C. and 736·8^{mm} = 14·10 per cent nitrogen.

			Calculated.	Found.
Cobalt	2	118	9·83	9·87
Iodine	6	762	63·50	63·70
Nitrogen	12	168	14·00	14·10
Hydrogen	24	24	2·00	
Oxygen	8	128	10·67	
		1200	100·00	

If we consider NO_2 as in part triatomic in this salt, the constitutional formula may be most simply represented by the expression: —

$$\overset{vi}{Co_2}\left\{\begin{array}{l} NH_3 - NO_2 \\ NH_3 - NO_2 = I_2 \\ NH_3 - NH_3 - I \\ NH_3 - NH_3 - I \\ NH_3 - NO_2 = I_2 \\ NH_3 - NO_2 \end{array}\right.$$

Nitrate. — I have already stated that the nitrate of this series may be formed by the action of a mixture of ammonia and ammonic nitrate upon a solution of cobaltic chloride and ammonic nitrate. It is much more convenient, however, to prepare it from the crude sulphate by double decomposition with baric nitrate. The sulphate is to be boiled with a small excess of baric nitrate and a little acetic acid, and the baric

sulphate carefully washed to avoid loss of nitrate. From the filtered solution the new salt crystallizes almost completely, on cooling, in beautiful orange-yellow needles, and sometimes in distinct prismatic forms. It is much more soluble than the sulphate, though cold water takes up but little. Boiling water and dilute acid solutions dissolve it more readily. The reactions of the base may be studied most conveniently with this salt. The formula of the nitrate is

$$Co_2(NH_3)_8(NO_2)_4(NO_3)_2,$$

as the following analyses show: —

0·2405 gr. gave 0·1333 gr. $CoSO_4$ = 21·10 per cent cobalt.
0·6564 gr. gave 0·2484 gr. water = 4·21 per cent hydrogen.
0·6148 gr. gave 173·5 c.c. nitrogen at 4·5° C., and 762·2^{mm} = 34·83 per cent.

			Calculated.	Found.
Cobalt	2	118	20·99	21·10
Hydrogen	24	24	4·27	4·21
Nitrogen	14	196	34·88	34·83
Oxygen	14	224	39·86	
		562	100.00	

The nitrate explodes, though not very violently, on being heated. Its solution gives with potassic ferrocyanide no precipitate at first, but after some hours beautiful garnet-red acicular crystals are formed. It is most easily distinguished from the nitrate of xanthocobalt by its crystalline form and by the extremely characteristic precipitates which its solution yields with potassic hyperiodide and with potassic chromate.

Chromate. — When a solution of potassic chromate is added to one of the nitrate of the octamin series, a most beautiful lemon-yellow salt is formed, which separates almost immediately in very brilliant scales which appear to belong to the quadratic system, and to be isomorphous with the sulphate. The salt is but slightly soluble in water. Its marked crystalline form renders it valuable in distinguishing the salts of this series from those of xanthocobalt. In this salt,

0·4660 gr. gave 0·2128 gr. $BaCrO_4$ = 20·95 per cent CrO_4.
0·4659 gr. gave 119·5 c.c. nitrogen at 9·75° C. and 753·5^{mm} = 30·42 per cent.

The formula, $Co_2(NH_3)_8(NO_4)_4CrO_4$, requires 20·97 per cent CrO_4 and 30·42 per cent of nitrogen.

Dichromate. — This salt is easily formed by adding a solution of potassic dichromate to one of the octamin nitrate. It separates after a few minutes in beautiful orange-yellow needles, which may be redis-

solved and again crystallized without decomposition. In appearance and solubility it can hardly be distinguished from the corresponding salt of xanthocobalt,

$$Co_2(NH_3)_{10}(NO_2)_2(Cr_2O_7)_2.$$

The formula of this salt is:—

$$Co_2(NH_3)_8(NO_2)_4Cr_2O_7.$$

0·5604 gr. gave 0·4315 gr. $BaCrO_4$ = 32·91 per cent Cr_2O_7.

The formula requires 33·06 per cent. The determination of CrO_4 and Cr_2O_7, in this and similar compounds containing NO_2, can be effected more accurately by means of a baric salt than by mercurous nitrate, since the nitrous compound always reduces a little chromic acid to chromic sesquioxide.

Platino-chloride. — A solution of sodic platino-chloride, $PtCl_6Na_2$, produces in one of the new nitrate after a time fine orange-brown prismatic crystals, which, however, cannot easily be recrystallized without decomposition. The crystals were washed with cold water, dried by pressure, and then over sulphuric acid. The analysis was made by boiling the salt with zinc and dilute sulphuric acid, filtering off and weighing the reduced platinum and determining the chlorine in the filtrate by silver. In another portion of the salt the platinum and cobalt were determined together by gentle ignition in a current of hydrogen gas. In this manner,

0·3959 gr. gave 0·0921 gr. platinum and 0·3016 gr. silver = 23·26 per cent platinum and 25·04 per cent chlorine.

0·4459 gr. gave 0·1652 gr. platinum and cobalt = 37·04 per cent. Subtracting 23·26 per cent platinum from this, we have 13·78 per cent cobalt.

		Calculated.	Found.
Cobalt	2	13·91	13·78
Chlorine	6	25·12	25·04
Platinum	1	23·23	23·26

The formula of this salt is therefore:—

$$Co_2(NH_3)_8(NO_2)_4Cl_2 + PtCl_4.$$

Auro-chloride. — A solution of auro-chloride of sodium, $AuCl_4Na$, produces immediately in one of the octamin nitrate a beautiful crystalline precipitate, with a fine canary-yellow color and silky lustre. Small quantities of this salt may be dissolved in boiling water without decomposition, but it is very difficult to recrystallize it without great loss from the reduction of the gold. When boiled for a short time the

salt is almost completely decomposed. It is remarkably insoluble in cold water. For analysis the salt was dried on bibulous paper, and afterward in pleno over sulphuric acid. The analysis was effected by boiling the salt with zinc as in the case of the platinum salt, and determining the chlorine in the filtrate by silver, but the gold precipitated was found to contain much metallic cobalt. Another analysis was made by simply heating with sulphuric acid, precisely as in the process which Genth and myself introduced for the determination of cobalt in these salts, and then washing and weighing the gold. This method was found to give excellent results. In this manner,

0·4791 gr. gave 0·3697 gr. silver = 25·36 per cent chlorine.

0·3942 gr. gave 0·2483 gr. Au + $CoSO_4$ and 0·1391 gr. gold, and by difference 0·1092 gr. $CoSO_4$ = 10·54 per cent cobalt and 35·30 per cent gold.

		Calculated.	Found.
Cobalt	2	10·57	10·54
Gold	2	35·30	35·30
Chlorine	8	25·44	25·36

The formula of the salt is therefore: —

$$Co_2(NH_3)_8(NO_2)_4Cl_2 + 2AuCl_3.$$

Erdmann's Salt. — O. L. Erdmann,* in 1866, described a remarkable salt which is formed when a solution of potassic nitrite is added to a solution of cobaltic chloride containing an excess of ammonic chloride. The liquid quickly assumes a dark orange color, becomes strongly acid and evolves red vapors. After a time very beautiful oblique rhombic crystals are deposited, which, according to Erdmann, have the formula (old style)

$$Co_2O_3 2NH_3, 3NO_3 + KO,NO_3.$$

In modern notation the formula of Erdmann's salt may be written: —

$$Co_2(NH_3)_4(NO_2)_8K_2.$$

Erdmann states that the potassium in this salt may be replaced by other metals, and describes the corresponding ammonium and silver salts. These compounds are especially interesting because they hold an intermediate position between the two series represented respectively by the terms

$$Co_2(NH_3)_{12}Cl_6 \text{ and } Co_2(NO_2)_{12}K_6.$$

* Journal für prakt. Chemie, xcvii. 385.

I propose therefore to speak of them more in detail hereafter, and to confine myself at present to their relations to the salts of the octamin series.

When a solution of Erdmann's salt, $Co_2(NH_3)_4(NO_2)_8K_2$, is added to one of the octamin nitrate, a beautiful crystalline precipitate is formed, which after washing with cold water may be redissolved in hot water and then separates in fine orange-yellow granular crystals. The equation representing the reaction is here

$$Co_2(NH_3)_8(NO_2)_4(NO_3)_2 + Co_2(NH_3)_4(NO_2)_8K_2 = 2KNO_3 + \}Co_2(NH_3)_4(NO_2)_8\}''\{(Co_2(NH_3)_8(NO_2)_4\}''.$$

The new salt gives with reagents the reactions of the salts of the octamin series. The relation between the two complex atoms which form a molecule of the new salt is worthy of notice, the number of atoms of ammonia and nitroxyl in the one corresponding to the number of atoms of nitroxyl, NO_2, and of ammonia in the other; one complex atom being, to use Graham's convenient expression, chlorous and the other zincous. We have furthermore the relation expressed by the equation: —

$$\{Co_2(NH_3)_4(NO_2)_8\}\{(Co_2(NH_3)_8(NO_2)_4\} = 2Co_2(NH_3)_6(NO_2)_6.$$

Now I shall show, farther on, that there exist several other salts, the empirical constitutions of which may be represented also by multiples of the formula

$$Co_2(NH_3)_6(NO_2)_6,$$

so that we have here, for the first time, I believe, in inorganic chemistry, a series of strictly metameric bodies. In the salt of the octamin series,

0·2600 gr. gave 0·1622 gr. $CoSO_4 = 23·74$ per cent cobalt.

The formula requires 23·79 per cent.

The salts which I have described are not the only ones which contain 8 atoms of ammonia with 2 atoms of cobalt. In our memoir Genth and I made mention of a leek-green crystalline body which we obtained in more than one reaction in quantities too small for analysis, and which we termed, provisionally, Praseocobalt. Braun subsequently denied the existence of any such substance; but, in an excellent paper on the ammonia-cobalt compounds, F. Rose has not merely described and analyzed the body in question, but has given a method of preparing it in quantity. Rose gives for the formula of this salt Co_2Cl_3 N_4H_{12} (old style). I should write this

$$Co_2(NH_3)_8Cl_6,$$

and give it the atomistic formula

$$Co_2\begin{cases} NH_3-Cl \\ NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-Cl \\ NH_3-Cl \end{cases}$$

It thus forms the type of a special octamin series, the relations of which to the salts which I have described are easily seen by comparing the formulas which I have given. Rose has not described any other salts of this series. It seems possible that my series may be derived from this by acting upon the chloride with argentic nitrite: we may have

$$Co_2(NH_3)_8Cl_6 + 4AgNO_2 = Co_2(NH_3)_8(NO_2)_4Cl_2 + 4AgCl,$$

but I have as yet made no experiments in this direction. Finally Künzel * described, many years since, a hyposulphate, to which he gave the formula $Co_2O_3 + 4NH_3 + 2S_2O_5$ (old style). This formula becomes, in my view, $Co_2(NH_3)_8S_4O_{12}$, and the salt then belongs to the octamin series; but it is possible that its empirical constitution has not yet been correctly given.

In treating of the salts of my new series, it appeared to me more in accordance with the theoretical views which I have adopted to abstain from trivial names. All the members of this series may however be regarded as containing the complex atom $Co_2(NH_3)_8(NO_2)_4$, which alone is constant and which from one point of view may be regarded as a diatomic radical or residue, and those who justify the use of trivial names by their convenience may find the name "Croceocobalt" expressive and appropriate.

5. The salts described by Fremy † under the names of chloride, nitrate, and sulphate of Fuscocobalt contain also eight atoms of ammonia, and may be regarded as belonging to the octamin series. These salts have, according to Fremy, respectively the formulas: —

$$Co_2(NH_3)_8 . O . Cl_4 + 3OH_2,$$
$$Co_2(NH_3)_8 . O . (NO_3)_4 + 3OH_2,$$
$$Co_2(NH_3)_8 . O . (SO_4)_2 + 4OH_2,$$

in modern notation. They are brown resinous masses, are difficult to obtain in a state of purity, and have as yet been but little studied. If

* Journal für prakt. Chemie, lxxii. 218.

† Ann. de Chimie et de Physique [3], tome xxxv. p. 257.

we admit that the formulas are accurate, we may write them, in accordance with the theoretic views which I have adopted, as follows:* —

$$Co_2\left\{\begin{array}{l} NH_3-Cl \\ NH_3-Cl \\ NH_3-NH_3 \\ NH_3-NH_3 \\ NH_3-Cl \\ NH_3-Cl \end{array}\right. \!\!\begin{array}{l} \\ \\ \!>O \\ \\ \\ \\ \end{array} \quad Co_2\left\{\begin{array}{l} NH_3-NO_3 \\ NH_3-NO_3 \\ NH_3-NH_3 \\ NH_3-NH_3 \\ NH_3-NO_3 \\ NH_3-NO_3 \end{array}\right. \!\!\begin{array}{l} \\ \\ \!>O \\ \\ \\ \\ \end{array} \quad Co\left\{\begin{array}{l} NH_3 \\ NH_3 \\ NH_3-NH_3 \\ NH_3-NH_3 \\ NH_3 \\ NH_3 \end{array}\right. \!\!\begin{array}{l} >SO_4 \\ \\ >O \\ \\ >SO_4 \\ \\ \end{array}$$

Jörgensen † suggests that these salts may contain hydroxyl in place of oxygen. There is at present no method of deciding the question, and I have adopted the view which seems to me the most probable. Künzel's hyposulphate above mentioned may be regarded as belonging to this series, and as having the structural formula: —

$$Co_2\left\{\begin{array}{l} NH_3 \\ NH_3 \\ NH_3-NH_3 \\ NH_3-NH_3 \\ NH_3 \\ NH_3 \end{array}\right. \!\!\begin{array}{l} >S_2O_6 \\ \\ >O \\ \\ >S_2O_6 \\ \\ \end{array}$$

but, according to Geuther, the formula given by Künzel must be tripled, and the salt then belongs to the dodecamin or luteocobalt series. In the absence of direct proof of the existence of luteocobalt in this salt, Künzel's formula appears the more probable of the two. The compounds above mentioned, with those which I have myself described, form the only known members of the octamin group, a further study of which will doubtless yield an ample return.

6. *Action of Ammonic Nitrite on Salts of Cobalt.* — To obtain a clear view of the nature and mode of formation of the salts of xanthocobalt, I have carefully studied the relations of ammonic nitrite to salts of cobalt under different conditions. This subject has already been examined by Erdmann,‡ and in my laboratory by Sadtler. § Erdmann found that when a neutral solution of cobaltic chloride is mixed with a neutral solution of ammonic nitrite no turbidity ensues; but after spontaneous evaporation in the air a salt crystallizes, with the formula, as Erdmann writes it (old style): —

$$\overbrace{Co_2O_3 . 2}NH_3, 3NO_2 + NH_4O, NO_2.$$

* Blomstrand has given the same formulas with trifling variations. Chemie der Jetztzeit, p. 355.

† Gmelin-Krauts' Handbuch, vol. iii. p. 468.

‡ Journal für prakt. Chemie, xcvii. 385.

§ Am. Journal of Science and Arts [2], ix. 189.

This salt is isomorphous with the corresponding potassium salt, the crystals belonging to the rhombic system. Erdmann does not explain the reaction which takes place in the formation of this or the corresponding potassium salt, and regards the compounds in question as double salts. When slightly acid solutions were employed, Erdmann obtained, in addition to the above-mentioned salt, an ammonic salt corresponding to Fischer's salt, $Co_2(NO_2)_{12}(NH_4)_6 + 2OH_2$, as we should now write it. The existence of this salt was first remarked by Genth and myself.* Sadtler studied the action of ammonic nitrite on acid solutions of cobaltic chloride, and obtained two salts having respectively the formulas:—

$$Co_2(NO_2)_{10}(NH_4)_4 + 2OH_2,$$
$$Co_2(NO_2)_{12}(NH_4)_6 + 2OH_2,$$

but did not observe the formation of Erdmann's ammonium salt. In repeating these experiments, I always obtained Erdmann's ammonium salt, $Co_2(NH_3)_4(NO_2)_8(NH_4)_2$, in largest quantity. The crystals are uncommonly beautiful and well defined. Of these crystals,

0·3390 gr. gave 0·1783 gr. $SO_4Co = 20{\cdot}02$ per cent.

The formula requires 20·00 per cent. In one experiment, in which a little free acetic acid was present, I obtained large, dark sherry-wine colored prismatic crystals, which after solution and recrystallization gave only very thin lozenge-shaped tabular crystals, the form and appearance of which are highly characteristic. These crystals gave no reactions with salts of luteocobalt, purpureocobalt, and roseocobalt, and none with potassic chromate and dichromate, ammonic oxalate or argentic nitrate. The absence of the first-mentioned reactions shows that they do not contain $Co_2(NH_3)_4(NO_2)_8$ or $Co_2(NO_2)_{12}$, while the fact that they give no reactions with alkaline chromates and oxalates shows that they do not contain any known cobaltamin. Of these crystals,

0·1554 gr. gave 0·0974 gr. $SO_4Co = 23{\cdot}86$ per cent cobalt.
0·3081 gr. gave 0·0635 gr. $NH_3 = 20{\cdot}61$ per cent ammonia.

The formula $Co_2(NH_3)_6(NO_2)_6$ requires:—

Cobalt,	23·79	23·86
Ammonia,	20·56	20·61

These analyses are sufficient to identify the salt in question with one which Erdmann has described in the paper referred to as formed by the action of ammonia and potassic nitrite upon cobaltic chloride,

* This Journal, 2d Series, vol. xxiv. p. 86.

unfortunately with but very scanty details. I attribute to this salt the formula

$$Co_2 \left\{ \begin{array}{l} NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NO_2 \end{array} \right.$$

and consider it to be the nitrous representative of the hexamin $Co_2(NH_3)_6$. I have not succeeded in obtaining from it other members of the same series; but it is, to say the least, probable that the dichro-cobalt-chloride of Fr. Rose,* $Co_2(NH_3)_6Cl_6 + 2OH_2$, represents the corresponding chloride. Künzel † has described a sulphite to which he attributes the formula

$$Co_2(NH_3)_6(SO_3)_3 + OH_2,$$

but according to Geuther ‡ this formula must be doubled, the salt belonging to the dodecamin or luteocobalt series, with the formula

$$Co_2(NH_3)_{12}(SO_3)_6 + Co_2(SO_3)_6 + 2OH_2.$$

Erdmann's hexamin salt is of special interest, because, as I shall show, it forms the first term in a remarkable series of metameric bodies: its formation under the circumstances may with great proba bility be expressed by the equation

$$2CoCl_2 + 10NH_4 . NO_2 + 3O = Co_2(NH_3)_6(NO_2)_6 + 4NH_4Cl + 3OH_2 + 4NO_2,$$

as the salt is not formed immediately, but only after absorption of oxygen from the air. The formation of Erdmann's ammonium salt may in like manner be represented by the equation

$$2CoCl_2 + 10NH_4 . NO_2 + 2O = Co_2(NH_3)_4(NO_2)_8(NH_4)_2 + 4NH_4Cl + 2OH_2,$$

the presence of oxygen being necessary in this case also.

In another experiment I obtained no hexamin nitrite, but only Erdmann's ammonium salt and the two salts described by Sadtler, and to which he gave respectively the formulas: —

$$Co_2(NO_2)_{10}(NH_4)_4 + 2OH_2,$$
$$Co_2(NO_2)_{12}(NH_4)_6 + 2OH_2.$$

These last salts were formed in considerable quantity mixed together as a yellow sparingly soluble crystalline powder, when a strong solution

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* Untersuchungen über ammoniakalische Kobalt-Verbindungen. Heidelberg, 1871.

† Journal für prakt. Chemie, 72, p. 209. ‡ Ann. de Pharmacie, 128, p. 127.

of ammonic nitrite was poured upon finely pulverized cobaltic chloride, and acetic acid was added in small excess. I consider the formation of these two salts to be represented by the equations: —

$$2CoCl_2 + 10NH_4 . NO_2 + 3O = Co_2(NO_2)_{10}(NH_4)_4 + 6NH_3 + 3OH_2,$$
$$2CoCl_2 + 12NH_4 . NO_2 + 3O = Co_2(NO_2)_{12}(NH_4)_4 + 8NH_3 + 3OH_2.$$

Professor Sadtler has shown that in these cases also an absorption of oxygen from the air takes place. When a solution of ammonic nitrite is added to a strong alcoholic solution of cobaltic chloride, Erdmann's ammonium salt, $Co_2(NH_3)_4(NO_2)_8(NH_4)_2$, is chiefly formed, and only a small quantity of the four and six atom salts. The compound formed crystallizes from the alcoholic solution in very beautiful and well defined prismatic forms.

From the above it will be seen that at least four distinct compounds are formed by the action of ammonic nitrite upon solutions of cobaltic chloride in presence of a weak acid and of the oxygen of the air. It is at least probable that all four are formed at the same time, though in varying proportions. I have already shown that, in the presence of free ammonia and of ammonic nitrate, cobaltic chloride and ammonic nitrite yield the nitrate of the octamin series. Of the action of ammonic nitrite upon cobaltic salts in the presence of free ammonia, I shall speak in treating of the formation of the salts of xanthocobalt.

7. I have stated above that Erdmann obtained the hexamin nitrite, $Co_2(NH_3)_6(NO_2)_6$, by the joint action of potassic nitrite and ammonia upon cobaltic chloride. On repeating his experiments, I found that small quantities of this salt were formed, but that the chief products of the action were salts of xanthocobalt, the formation of which Erdmann does not appear to have noticed. Small quantities of salts of the octamin series are also formed. The filtered solution obtained in this reaction was precipitated by potassic dichromate, and the orange-red needles obtained recrystallized for analysis. Of these crystals,

0·6145 gr. gave 0·7393 gr. $CrO_4Ba = 51·40$ per cent Cr_2O_7.
0·7712 gr. gave 0·9277 gr. $CrO_4Ba = 51·40$ per cent Cr_2O_7.
0·5615 gr. gave 96·5 c.c. nitrogen (moist) at 15° C. and 763·1^{mm} = 20·12 per cent nitrogen.
0·5028 gr. gave 86 c.c. nitrogen (moist) at 15° C. and 763·1^{mm} = 20·05 per cent nitrogen.

The formula $Co_2(NH_3)_{10}(NO_2)_2Cr_2O_7$ requires 53·22 per cent Cr_2O_7 and 20·67 per cent nitrogen, while the formula of the octamin salt, $Co_2(NH_3)_8(NO_2)_4Cr_2O_7$, requires 32·91 per cent Cr_2O_7 and 19·30 per cent nitrogen, so that the analyses leave no reasonable doubt that the

salt was a mixture of a salt of xanthocobalt with a smaller proportion of the corresponding salt of the octamin series.

The above results clearly show that the action of alkaline nitrites upon salts of cobalt in presence of free acid is extremely complex, not less than six classes of salts being formed, of which two belong certainly to basic series, while three may be regarded as salts of ammonium. The sixth, $Co_2(NH_3)_6(NO_2)_6$, is probably also one term in a hexamin series.

8. The ammonia-nitrites discovered by Erdmann are of especial interest. They present the first and at present the only known instance in which cobalt, by uniting with ammonia and nitroxyl, NO_2, forms an electro-negative or chlorous radical. The compound $Co_2(NH_3)_4(NO_2)_8$ may be regarded as existing in combination with two atoms of a monatomic radical, exactly as the compound $Co_2(NH_3)_8(NO_2)_4$ combines with two atoms of chlorine. The structural formulas may be written respectively: —

$$Co_2\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NO_2 \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NO_2 \\ NH_3-NO_2 \end{array}\right. \qquad Co_2\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NO_2 \\ N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \\ NH_3-NO_2 \\ NH_3-NO_2 \end{array}\right.$$

With these formulas we may advantageously compare those of chloride of luteocobalt, of Fischer's salt considered as anhydrous, and of chloride of xanthocobalt: —

$$Co_2\left\{\begin{array}{l} NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \end{array}\right. \qquad Co_2\left\{\begin{array}{l} N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \\ N{<}\substack{O\\O}{>}N-O-OK \end{array}\right.$$

$$Co_2\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NO_2 \end{array}\right.$$

The manner in which these compounds may be derived from each other by replacement is sufficiently obvious, and is best seen by assuming chloride of luteocobalt and Fischer's salt as the two extreme terms of the series in which the other three are intermediate.

Erdmann's analyses leave no reasonable doubt as to the constitution of the ammonia-nitrites. I have thought it worth while, however, to make a few additional analyses in support of his view. In the potassium salt,

0·4497 gr. gave 0·3397 gr. SO_4Co and SO_4K_2 = 75·54 per cent.
0·7338 gr. gave 0·5615 gr. „ „ = 76·52 per cent.
0·5937 gr. gave 127 c.c. nitrogen at 6·5° C., and 773·4^{mm} = 26·45 per cent nitrogen.

The formula $Co_2(NH_3)_4(NO_2)_8K_2$ requires 76·58 per cent ($2SO_4Co + SO_4K_2$) and 26·58 per cent nitrogen. In the silver salt,

0·3580 gr. gave 0·2902 gr. SO_4Co and SO_4Ag_2.
0·5937 gr. gave 0·1675 gr. silver = 28·21 per cent.

The cobalt by difference amounts to 15·33 per cent. The formula $Co_2(NH_3)_4(NO_2)_8Ag_2$ requires 28·05 per cent silver and 15·32 per cent cobalt.

Thallium Salt. — When a solution of the potassium salt is added to one of thallous nitrate, a beautiful sherry-wine-colored crystalline precipitate is thrown down, which on recrystallization gives very well-defined prismatic crystals, having apparently the same form as the corresponding potassium and ammonium salts.

Mercurous Salt. — A solution of potassic ammonia-cobalt-nitrite gives immediately in solutions of mercurous nitrate a beautiful orange-colored crystalline precipitate, which may be dissolved in boiling water, but not without partial decomposition. The salt does not crystallize well from the solution. Of this salt,

0·7785 gr. gave 0·1775 gr. SO_4Co = 8·68 per cent cobalt.

The formula $Co_2(NH_3)_4(NO_2)_8(Hg_2)_2$ requires 8·71 per cent.

A solution of the potassic salt gives no precipitate with salts of cobalt, nickel, barium, and copper, and none at first with plumbic acetate. After standing, however, a lead salt separates in fine acicular leafy crystals of a brown-orange color, soluble in hot water, but with partial decomposition. The same is true of the silver salt, but small quantities of this may usually be dissolved and recrystallized without change. The silver salt is extremely well characterized; its moderate degree of

solubility and the facility with which it crystallizes in tabular lustrous crystals have made it of great service in my investigations, especially in distinguishing salts containing $Co_2(NH_3)_4(NO_2)_8$ from those which contain $Co_2(NO_2)_{12}$. Compounds of ammonia-cobalt-nitrite with barium, strontium, &c., are easily formed by double decomposition, the metallic chlorides being digested with a solution of the argentic salt. They are pale orange-yellow, soluble salts which I have not further examined. A solution of the potassic salt gives beautiful crystalline precipitates with salts of various organic alkaloids, especially with those of brucin and strychnin. These are soluble in hot water without sensible decomposition, and may be recrystallized. Salts of anilin give a bright yellow precipitate with potassic ammonia-cobalt-nitrite, which is, however, immediately decomposed, phenol being set free. The potassic salt gives also splendid crystalline precipitates with salts of croceocobalt, xanthocobalt, luteocobalt, &c. I have already noticed the salt of croceocobalt, and will describe the salts of the other bases in due course.

Erdmann has not attempted to explain the formation of this class of salts. He remarks that a yellow insoluble compound is formed at the same time with the potassic salt $Co_2(NH_3)_4(NO_2)_8K_2$, which appears to be a mixture which cannot be obtained pure for analysis. I have also obtained this body, and also regard it as consisting mainly of Fischer's salt, $Co_2(NO_2)_{12}K_6$, though, as Erdmann states, it contains a small percentage of ammonia. The formation of the salt $Co_2(NH_3)_4(NO_2)_8K_2$ may be expressed by the equation

$$2CoCl_2 + 4NH_4Cl + 8KNO_2 + O = Co_2(NH_3)_4(NO_2)_8K_2 + 6KCl + 2HCl + OH_2,$$

if we suppose oxygen to be absorbed from the air. In consequence, however, of the formation of free chlorhydric acid, N_2O_3 is set free, and it is much more probable that this is reduced by the nascent hydrogen; so that we have

$$N_2O_3 + 2H = 2NO + OH_2.$$

The potassium salt is also formed, as I shall show, in various other cases: the similarity of some of its reactions to those of a solution of $Co_2(NO_2)_{12}Na_6$ in sodic nitrite for a long time misled me; but its relations to salts of silver, mercury, and thallium enable us to recognize its presence with absolute certainty. The salt does not enter into combination with iodine.

XANTHOCOBALT.

9. Genth and I have shown in our memoir that the salts of xanthocobalt may be formed either directly by the action of nitrous acid vapors upon salts of cobalt, or by the action of the same acid upon salts of purpureocobalt and roseocobalt, in each case in the presence of free ammonia. I propose now to give the results of a more detailed study of the subject.

With respect to the constitution of this class of salts, I may remark, in the first place, that Genth and I left it undecided whether the salts in question contain NO or NO_2, pointing out the fact that the analyses do not decide in favor of either view, and adopting the former provisionally. Braun first proved conclusively that the salts of xanthocobalt contain NO_2, and this view has since been generally adopted. I have already shown (§ 1) that when cobaltic chloride, $CoCl_2$, is mixed with ammonia and ammonic nitrite and nitrate, the solution absorbs oxygen from the air, while the nitrate of the octamin series, $Co_2(NH_3)_8(NO_2)_4(NO_3)_2$, is formed. I have not observed in this reaction the formation of a salt of xanthocobalt. If present at all, such salts must be formed in very small relative quantity. Genth and I have shown, on the other hand, that when the red gases resulting from the action of nitric acid upon starch, sawdust, or arsenous oxide are passed into solutions of cobaltic salts in presence of an excess of ammonia, salts of xanthocobalt are formed in a very short time, and in large quantity.

If we consider the red gas to consist of hyponitric oxide, N_2O_4, we may have

$$2Co(NO_3)_2 + 10NH_3 + N_2O_4 = Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4.$$

In preparing sulphate and nitrate of xanthocobalt by this process, I have on several occasions been able to detect only salts of this base among the products of the reaction. In one case, however, in which I employed cobaltic sulphate and added so large a quantity of ammonic sulphate that the solution gave no precipitate with ammonia, I obtained a very large relative quantity of Erdmann's salt $Co_2(NH_3)_6(NO_2)_6$. In other cases in which cobaltic chloride was present I detected crystals of the chloro-nitrate $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2$. The solutions after the action of the red gases also contain small quantities of the ammonia-cobalt-nitrite of ammonium, $Co_2(NH_3)_4(NO_2)_8(NH_4)_2$, as well as ammonic nitrite and nitrate.

On the other hand, however, I have already shown (§ 3) that salts of this radical are formed in large quantity, together with a smaller

proportion of the octamin nitrate, by the action of a mixture of potassic nitrite and ammonia upon cobaltic nitrate in presence of air; but that xanthocobalt is exclusively formed by the action of the same mixture upon a solution of ammonic and cobaltic sulphates. I am unable to offer any plausible explanation for the difference of the products in the two cases.

When cobaltic nitrate, ammonic nitrite, and ammonia are mixed and placed in a tightly corked bottle, no action whatever appears to take place, even after the mixture has stood some days. But if plumbic hyperoxide, PbO_2, is added, the mixture soon becomes yellow, and after a few hours large crystals of nitrate of xanthocobalt are formed, with distinct reduction of the plumbic hyperoxide. The reaction in this case may be represented by the equation:—

$$2Co(NO_3)_2 + 10NH_3 + 2NH_4 . NO_2 + PbO_2 = Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 + PbO + (NH_4)_2O.$$

Potassic hypermanganate may also be employed as an oxidizing agent, but is less convenient. The experiment just detailed appears to me to render it most probable that in the action of the red gases upon salts of cobalt in presence of ammonia, the resulting salts of xanthocobalt are not formed by the direct union of the cobaltic salt with ammonia and nitroxyl, but that ammonic nitrite is first formed, and that the oxygen necessary for the completion of the reaction is derived from the decomposition of some element of the complex mixture of NO, NO_2, N_2O_3, and NO_3H, which make up the red vapors.

The formation of salts of xanthocobalt by the action of the red gas upon salts of purpureocobalt and roseocobalt in the presence of free ammonia is easily explained. We have here simple cases of double decomposition, a particular instance of which, covering in substance the whole ground, may be expressed by the equation:—

$$Co_2(NH_3)_{10}(NO_3)_6 + 2NH_4 . NO_2 = Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 + 2NH_4 . NO_3.$$

Salts of xanthocobalt are always formed when salts of purpureocobalt and roseocobalt are heated or even digested in the cold with alkaline nitrites. I have made a special study of the action of potassic and sodic nitrites upon chloride of purpureocobalt, the details of which are as follows:

10. *Action of Sodic and Potassic Nitrites upon Chloride of Purpureocobalt.*— A quantity of chloride of purpureocobalt was dissolved in boiling water, with a little free acetic acid to prevent decomposition,

and added to a hot solution of potassic nitrite in excess. The dark brown-red solution was evaporated at a gentle heat to half its volume. On cooling, a small quantity of Fischer's salt, $Co_2(NO_2)_{12}K_6 + 2OH_2$, separated; afterward sherry-wine-colored prismatic crystals were formed in abundance. After recrystallization, these were analyzed.

0·2824 gr. gave 0·1519 gr. $CoSO_4 =$ 20·47 per cent cobalt.
0.5557 gr. gave 0·2092 gr. silver = 12·37 per cent chlorine.

The same experiment was made with sodic nitrite, and with similar results. After two recrystallizations the salt formed was analyzed.

0·4163 gr. gave 0·2235 gr. $CoSO_4 =$ 20·43 per cent cobalt.
0·2332 gr. gave 0·0876 gr. silver = 12·38 per cent chlorine.
0·6625 gr. gave 192·12 c.c. nitrogen (moist) at 14° C. and $764{\cdot}1^{mm} =$ 34·29 per cent.
1·2310 gr. gave 0·5825 gr. water = 5·24 per cent hydrogen.
1·6542 gr. gave 0·7996 gr. water = 5·37 per cent hydrogen.

The salt being found to lose no water on heating, the analyses agree with the formula: —

$$Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2,$$

which requires: —

		Found.	
Cobalt,	20·52	20·47	20·43
Chlorine,	12·34	12·37	12·38
Hydrogen,	5·26	5·24	5·37
Nitrogen,	34·09	34·20	

and which is fully sustained by other considerations, as I shall show. As the solutions of the alkaline nitrites employed also contained nitrates, the formation of the new salt may be represented by the equation: —

$$Co_2(NH_3)_{10}Cl_6 + 2KNO_2 + 2KNO_3 = 4KCl + Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2.$$

The salt itself is then a nitroso-chloro-nitrate, and belongs probably to the α-decamin or purpureocobalt series; but it may be more conveniently regarded as the chloro-nitrate of xanthocobalt. It has the wine color of the salts of the so-called xanthocobalt series, and crystallizes usually in prismatic forms, which are moderately soluble in hot water, and separate readily from the solution. With neutral potassic chromate the salt gives the beautiful yellow crystalline chromate of xanthocobalt: —

$$Co_2(NH_3)_{10}(NO_2)_2(CrO_4)_2 + 2OH_2.$$

With potassic ferrocyanide it gives the characteristic red prismatic crystals of

$$Co_2(NH_3)_{10}(NO_2)_2FeCy_6 + 6OH_2;$$

and with ammonic oxalate, oxalate of xanthocobalt,

$$Co_2(NH_3)_{10}(NO_2)_2(C_2O_4)_2,$$

the reactions being too obvious to require explanation by equations.

As it is difficult to prevent the action of the alkaline nitrites upon chloride of purpureocobalt from going too far and decomposing the new salt first formed, I had recourse to a different mode of preparation, by which the salt can be prepared in any quantity and with the greatest facility. A hot solution containing one molecule of chloride of xanthocobalt was mixed with a solution containing one molecule of nitrate of xanthocobalt. On cooling, the chloro-nitrate crystallized in beautiful prismatic forms. In this case we have

$$Co_2(NH_3)_{10}(NO_2)_2Cl_4 + Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 = 2Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2.$$

Of the crystals so formed,

0·6203 gr. gave 0·3310 gr. $CoSO_4$ = 20·31 per cent cobalt.
0·9268 gr. gave 0·3450 gr. silver = 12·24 per cent chlorine.

The formula requires 20·51 per cent cobalt and 12·34 per cent chlorine. A portion of the crystallized salt was dissolved and precipitated by argentic nitrate. The filtrate from AgCl gave on evaporation crystals of nitrate of xanthocobalt, in which

0·2972 gr. gave 0·1469 gr. $CoSO_4$ = 18·81 per cent cobalt.

The formula of the nitrate requires 18·73 per cent. These results leave no doubt as to the constitution and true relations of the chloro-nitrate.

Gold Salt. — When the chloro-nitrate is dissolved and a solution of aurochloride of sodium, $AuCl_4Na$, is added in excess, long prismatic wine-yellow crystals are formed. Of these crystals,

0·8564 gr. decomposed by zinc and sulphuric acid gave 0·6300 gr. silver = 24·16 per cent chlorine and 0·2858 gr. gold = 33·36 per cent.
0·4084 gr. gave 0·1770 gr. Au + Co = 43·34 per cent and by difference 9·98 per cent cobalt.

The formula, $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2 + 2AuCl_3$, requires: —

		Found.
Cobalt	9·98	9·98
Gold	33·33	33·36
Chlorine	24·03	24.16

The salt is readily decomposed by boiling with reduction of metallic gold.

Platinum Salt. — Platinic chloride in solution precipitates the chloro-nitrate almost immediately in the form of wine-yellow needles. After recrystallization the salt was analyzed with the following results: —

0·6405 gr. fused with potassio-sodic carbonate gave 0·5564 gr. silver = 28·55 per cent chlorine, 0·1986 gr. platinum = 31·00 per cent and 0·0597 gr. cobalt = 9·33 per cent.

The platinum and cobalt were weighed together as metals after reduction by hydrogen, and the cobalt was then dissolved by long boiling with nitric acid.

The formula, $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2 + 2PtCl_4$, requires: —

		Found.
Cobalt	9·40	9·33
Platinum	31·55	31·00
Chlorine	28·28	28·55

The salt lost no water on heating to 140° C.

Bromo-nitrate of Xanthocobalt. — One molecule of bromide of xanthocobalt was mixed with one of the nitrate of the same base, both salts being in solution in hot water. A dark, sherry-wine colored salt separated, after some hours, in well-defined crystals. In this salt

0·8925 gr. gave 0·4190 gr. SO_4Co = 17·86 per cent cobalt.
0·7116 gr. gave 0·1244 gr. silver = 12·94 per cent bromine.

The formula $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Br_2$ requires 17·77 per cent cobalt, and 24·09 per cent bromine. The salt was re-dissolved, and allowed to crystallize a second time. In the salt thus obtained

0·8538 gr. gave 0·3984 gr. SO_4Co = 17·76 per cent cobalt.
0·8474 gr. gave 0·2672 gr. silver = 23·62 per cent bromine.

These results leave no doubt that a definite bromo-nitrate, analogous to the chloro-nitrate, is found by direct union of the nitrate and bromide. The salt appears to be, however, much less stable than the corresponding chlorine salt. A portion of it was crystallized a third time, and then gave 23·04 per cent of bromine, indicating the commencement of a separation into bromide and nitrate. The facility with which the chloro-nitrate is formed by the direct union of its constituents, led me to attempt the formation of other new salts by a similar

process. I mixed one molecule of chloride of purpureocobalt, and one of nitrate of xanthocobalt, in the hope of obtaining a salt with the formula $Co_2(NH_3)_{10}(NO_2)(NO_3)_2Cl_3$, since

$$Co_2(NH_3)_{10}Cl_6 + Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 = 2Co_2(NH_3)_{10}(NO_2)(NO_3)_2Cl_3.$$

After boiling the mixture with a little free acetic acid, the solution deposited, on cooling, deep orange-red — apparently homogeneous — crystals. Of these

0·3145 gr. gave 0·1746 gr. SO_4Co = 21·13 per cent cobalt.
0·9203 gr. gave 0·5080 gr. silver = 17·99 per cent chlorine.

The formula $Co_2(NH_3)_{10}(NO_2)(NO_3)_2Cl_3$ requires 20.90 cobalt, and 18·86 per cent chlorine. The analyses seem to show that a salt having the composition given may exist. On recrystallization, the salt was more or less completely decomposed, as the following analyses show: —

0·2125 gr. gave 0·1161 gr. SO_4Co = 20·80 per cent cobalt.
0·5933 gr. gave 0·2470 gr. silver = 13·70 per cent chlorine.
0·7888 gr. gave 0·3308 gr. silver = 13·78 per cent chlorine.

These numbers approximate to those required by the formula, $Co_2(NH_3)_{10}(NO_2)_2(NO_3)_2Cl_2$. I attempted in like manner to form salts synthetically by mixing other salts in the proportions indicated by the equations: —

$$Co_2(NH_3)_{10}(NO_2)_6 + Co_2(NH_3)_{10}Cl_6 = Co_2(NH_3)_{10}(NO_2)_3Cl_3.$$
$$Co_2(NH_3)_{10}(NO_3)_6 + Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4 = Co_2(NH_3)_{10}(NO_2)(NO_3)_5.$$

The experiments led, however, to no definite results.

The chloro-nitrate above described is the salt to which I, at one time, attributed the formula

$$Co_2(NH_3)_{10}(NO_2)_4Cl_2 + 2OH_2,$$

and which I regarded as the chloride of a special radical, "flavo-cobalt," $Co_2(NH_3)_{10}(NO_2)_4$. The mere analyses can hardly distinguish with certainty between the two formulas, and I was for some time misled by an erroneous interpretation of my results. The compounds of cobalt containing ammonia and nitroxyl, NO_2, have in general the same color, and differ but little in solubility, so that it is extremely difficult to separate them; and in my analyses of what I believed to be the sulphate and nitrate of the same base, I had undoubtedly to deal

with impure salts of xanthocobalt. Krok* has described a salt with the formula $Co_2(NH_3)_{10}Cl(NO_2)_5 + 3OH_2$. There is no theoretical reason why such a compound should not exist, but Krok's analyses do not appear to me sufficient, as the cobalt, chlorine, and ammonia only were determined, and not the whole quantity of nitrogen in the salt. Moreover, it is not proved that the salt can be recrystallized without decomposition, or that it forms definite compounds with metallic chlorides.

As the chloride and nitrate of xanthocobalt are capable of uniting directly to form the chloro-nitrate above described, it might be supposed that the two salts are isomorphous, and, therefore, crystallize together in all proportions. According to Professor Dana's measurements, cited in the first part of this memoir, nitrate of xanthocobalt crystallizes in forms belonging to the dimetric or square prismatic system. Professor Cooke has kindly determined the form of the corresponding chloride, and finds that the crystals are either trimetric or monoclinic. The chloro-nitrate cannot, therefore, be regarded as a mixture of two isomorphous salts.

11. Finally, salts of xanthocobalt are formed by the action of Fischer's salt, $Co_2(NO_2)_{12}K_6$, upon salts of purpureocobalt and roseocobalt. When, for instance, chloride of purpureocobalt is dissolved in boiling water, with a little free acetic or chlorhydric acid, and $Co_2(NO_2)_{12}K_6$ is added, in small portions at a time, the violet color of the salt gradually disappears as the boiling continues, and the solution finally assumes a fine orange-brown tint. The filtered solution gives on cooling fine crystals of chloride of xanthocobalt, the reaction being probably expressed by the equation

$$Co_2(NO_2)_{12}K_6 + 3Co_2(NH_3)_{10}Cl_6 = 3Co_2(NH_3)_{10}(NO_2)_2Cl_4 + 6KCl + 2Co(NO_2)_2 + 2NO_2.$$

During the boiling red vapors are given off. In one experiment the chloride of xanthocobalt formed was analyzed, with the following results:—

0·5027 gr. gave 0·2987 gr. SO_4Co = 22·62 per cent cobalt.
0·7616 gr. gave 0·6351 gr. silver = 27·35 per cent chlorine.

The formula $Co_2(NH_3)_{10}(NO_2)_2Cl_4$ requires 22·52 per cent cobalt, and 27·09 per cent chlorine. The salt gave all the reactions of the chloride.

* Acta Univers. Lund, 1870.

On the other hand, Fischer's salt is an almost constant product of the action of the alkaline nitrites upon salts of the decamin series. I have already mentioned its occurrence among the products of the action of potassic and sodic nitrite upon chloride of purpureocobalt. When nitrate of xanthocobalt is boiled with potassic nitrite and a little acetic acid, Fischer's salt is formed in abundance, and the nitrate is gradually decomposed, without formation of any other product which I could detect.

Chromate. — When neutral potassic chromate is added to a solution of nitrate of xanthocobalt, a beautiful yellow crystalline precipitate is thrown down, which may be washed with cold water, in which it is but slightly soluble. Hot water also dissolves this salt in very small quantity. The chromate has the formula

$$Co_2(NH_3)_{10}(NO_2)_2(CrO_4)_2 + 2OH_2,$$

as the following analyses show:—

0·4340 gr. gave 0·3652 gr. CrO_4Ba = 35·96 per cent CrO_4.
0·3472 gr. gave 0·2900 gr. CrO_4Ba = 35·70 per cent CrO_4.
0·6954 gr. gave 0·3370 gr. water = 5·38 per cent hydrogen.

The salt lost only 0·68 per cent water on drying up to 145° C.

The formula requires 35·84 per cent CrO_4, and 5·24 per cent hydrogen. It is remarkable that the salt should retain its water of crystallization at so high a temperature. The neutral chromate of xanthocobalt furnishes the most convenient method of obtaining the chloride and sulphate of xanthocobalt in a state of purity. For this purpose the chromate is to be boiled with water and a little acetic acid, and a solution of baric chloride added until baric chromate is no longer formed. From the filtrate the chloride of xanthocobalt crystallizes readily, and a second crystallization gives the salt perfectly pure. The sulphate may then be prepared from the chloride by double decomposition with argentic sulphate. In the preparation of the chloride by the above process, it is not necessary to operate with pure nitrate, but the crude salt and solutions obtained directly by the action of the red gases upon cobaltic nitrate and ammonia may be employed. I am even disposed to consider double decomposition of the chromate with baric nitrate the easiest method of obtaining a perfectly pure nitrate of xanthocobalt.

Dichromate. — Potassic dichromate produces in strong solutions of nitrate of xanthocobalt a beautiful orange-yellow precipitate of crystalline needles, easily purified by recrystallization, a few drops of

acetic acid being added to prevent decomposition. The salt is easily soluble in hot water, and crystallizes readily, though not in well-defined crystals, from the solution. Like the neutral chromate, it is available as a means of recognizing salts of xanthocobalt, and of obtaining them in a state of purity. Of this salt

0·6570 gr. gave 0·8200 gr. $CrO_4Ba = 53·33$ per cent Cr_2O_7.
0·3974 gr. gave 0·4950 gr. $CrO_4Ba = 53·23$ per cent Cr_2O_7.
0·4868 gr. gave 0·1830 gr. $Cr_2O_3 = 53·40$ per cent Cr_2O_7.

The formula $Co_2(NH_3)_{10}(NO_2)_2(Cr_2O_7)_2$ requires 53·22 per cent.

Iodosulphates. — A solution of potassic iodide gives no precipitate at first with one of nitrate of xanthocobalt, but, after standing some time, pale brown yellow acicular crystals of the iodide $Co_2(NH_3)_{10}(NO_2)_2I_4$ are formed. When a solution of iodine in potassic iodide is added to one of nitrate of xanthocobalt, iodine is precipitated in crystals, but no hyperiodide is formed, as in the case of the iodide of the octamin series already described. Potassic iodide gives, with a solution of sulphate of xanthocobalt, brown-yellow needles, which, after re-solution, give larger prismatic crystals. Of these

0·5396 gr. gave 0·2207 gr. $SO_4Co = 15·57$ per cent cobalt.
0·8856 gr. gave 0·2689 gr. $SO_4Ba = 12·51$ per cent SO_4.
0·4541 gr. gave 0·1288 gr. silver $= 33·37$ per cent iodine.

The formula $Co_2(NH_3)_{10}(NO_2)_2SO_4I_2 + 2OH_2$ requires

	Calculated.	Found.
Cobalt, 2	15·40	15·57
Iodine, 2	33·16	33·37
SO_4 1	12·53	12·51

When a solution of iodine in potassic iodide is added to one of sulphate of xanthocobalt, very beautiful, deep ruby red, well-defined crystals are formed, which are readily decomposed by hot water, with evolution of iodine vapor, and cannot be recrystallized for analysis. Of these crystals

0·6094 gr. gave 86·5 c.c. nitrogen at 13° C. and $758·6^{mm}$ ($h = 2·08^{mm}$) $= 16·63$ per cent nitrogen.
0·2142 gr. gave 0·0687 gr. $SO_4Co = 12·21$ per cent cobalt.
0·6104 gr. gave 0·1870 gr. $SO_4Co = 11·64$ per cent cobalt.
0·3940 gr. gave 0·1672 gr. silver $= 49·90$ per cent iodine.
0·5437 gr. gave 0·2310 gr. silver $= 49·96$ per cent iodine.
0·3020 gr. gave 0·0724 gr. $SO_4Ba = 9·87$ per cent SO_4.
1·0627 gr. gave 0·2787 gr. $SO_4Ba = 10·80$ per cent SO_4.

The formula $Co_2(NH_3)_{10}(NO_2)_2SO_4I_4$ requires

		Calculated.	Found. 1	Found. 2
Cobalt,	2	11·99	12·21	11·64
Iodine,	4	51·60	49·90	49·96
SO_4	1	9·75	9·77	10·80
Nitrogen,	12	17·07		16·63

Salts 1 and 2 were from different preparations.

The analyses do not correspond as closely to the formula as might be wished, but it must be remembered that the salt cannot be recrystallized without decomposition, and is probably not quite free from the first described, or normal iodo-sulphate. The salt gives off iodine on heating. The structural formulas of the two salts may be written as follows: —

$$Co_2\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NH_3-I \\ \left.\begin{array}{l} NH_3-NH_3 \\ NH_3-NH_3 \end{array}\right> SO_4 \\ NH_3-NH_3-I \\ NH_3-NO_2 \end{array}\right. \qquad Co_2\left\{\begin{array}{l} NH_3-NO_2 \\ NH_3-NH_3-I \\ \left.\begin{array}{l} NH_3-NH_3-O \\ NH_3-NH_3-O \end{array}\right> S \left< \begin{array}{l} O-I \\ O-I \end{array}\right. \\ NH_3-NH_3-I \\ NH_3-NO_2 \end{array}\right.$$

This mode of writing the formulas, however, involves certain theoretical conclusions, which I shall examine in detail hereafter. I added $PtCl_6Na_2$ to a solution of sulphate of xanthocobalt, hoping to obtain a salt with the formula $Co_2(NH_3)_{10}(NO_2)_2(SO_4)Cl_2(PtCl_6)$, analogous to a platinum salt of roseocobalt, which I shall hereafter describe, and which has the formula $Co_2(NH_3)_{10}(SO_4)_2PtCl_6$. The beautiful crystalline precipitate formed proved to be only the salt $Co_2(NH_3)_{10}(NO_2)_2Cl_2PtCl_6 + OH_2$, described in the first part of this memoir. 0·3882 gr. gave 0·1612 gr. $Co + Pt = 41·52$. The formula requires 41·39 per cent.

Nitrite of Xanthocobalt. — When argentic nitrite is boiled with a solution of chloride of purpureocobalt, the liquid soon loses its fine violet color, and assumes the wine yellow tint of the salts of xanthocobalt. The filtrate from the argentic chloride gave, on careful evaporation, two distinct salts, — a salt in beautiful scaly crystals, and one in octahedral crystals. The two salts were separated by crystallization. Of the scaly salt

0·2854 gr. gave 0·2286 gr. $SO_4Co + SO_4Ag_2 = 79·97$ per cent.

The formula of the ammonia-cobalt-nitrite, $Co_2(NH_3)_4(NO_2)_8Ag_2$ requires 80·75 per cent, and the salt was easily identified by its appearance and properties, with the silver salt of Erdmann's series. As the

octahedral salt was rather difficult to obtain perfectly pure by this method, I had recourse to the decomposition of sulphate of roseocobalt by baric nitrite. A solution of the last-named salt is to be added to one of the sulphate as long as a precipitate is formed. The sherry-wine-colored filtrate is then to be cautiously evaporated, when fine dark wine-colored octahedral crystals form. Of these crystals

0·4750 gr. gave 0·2303 gr. $SO_4Co = 18{\cdot}46$ per cent cobalt.
0·1220 gr. gave 0·0594 gr. $SO_4Co = 18{\cdot}54$ per cent cobalt.
0·3129 gr. gave 0·0403 gr. water, when heated to 140° C. = 12·87 per cent.
0·4289 gr. gave 0·1141 gr. ammonia = 26·60 per cent.

The formula $Co_2(NH_3)_{10}(NO_2)_6 + 4OH_2$ requires

		Calculated.	Found.	
Cobalt,	2	18·55	18·46	18·54
Ammonia,	10	26·72	26·60	
Water,	4	11·32	12·87	

The percentage of water in the analysis is too high, and would seem to show that a slight decomposition of the salt had taken place. I attempted to determine the percentage of NO_2 in this salt by titrition with potassic hypermanganate, but though the analyses were made with the greatest care, I obtained as a mean of three determinations, agreeing well together, only 11·24 per cent, which would correspond to less than two atoms. In other cases also I found that the method could not be employed.

So far as the empirical formula is concerned, the salt may be regarded as a nitrite of purpureocobalt or roseocobalt, $Co_2(NH_3)_{10}(NO_2)_6 + 4OH_2$. Its solution gives, however, the reactions of salts of xanthocobalt with the greatest distinctness, and I regard it, therefore, as the normal nitrite of this series, with the formula $Co_2(NH_3)_{10}(NO_2)_2(NO_2)_4 + 4OH_2$. Its formation from sulphate of roseocobalt and baric nitrite is expressed by the equation:—

$$Co_2(NH_3)_{10}(SO_4)_3 + 3Ba(NO_2)_2 = Co_2(NH_3)_{10}(NO_2)_6 + 3SO_4Ba,$$

and from chloride of purpureocobalt and argentic nitrite, by the equation,

$$Co_2(NH_3)_{10}Cl_6 + 6AgNO_2 = Co_2(NH_3)_{10}(NO_2)_6 + 6AgCl.$$

The formation of the silver salt of Erdmann's series, $Co_2(NH_3)_4(NO_2)_8Ag_2$, is probably due to a secondary action, and may, perhaps, be expressed by the equation

$$Co_2(NH_3)_{10}(NO_2)_6 + 2AgNO_2 = Co_2(NH_3)_4(NO_2)_8Ag_2 + 6NH_3.$$

Ammonia-cobalt-nitrate of Xanthocobalt. — When a solution of potassic ammonia-cobalt nitrite is added to one of nitrate of xanthocobalt, a beautiful crystalline precipitate is formed, of a deep orange-red color, which requires a rather large quantity of boiling water for solution, and which may be recrystallized without decomposition. The solution gives the reactions of salts of xanthocobalt, and gives also, with argentic nitrate, the characteristic silver salt $Co_2(NH_3)_4(NO_2)_8Ag_2$. Of this salt

0·5074 gr. gave 0·3172 gr. $SO_4Co = 23·77$ per cent cobalt.
0·4731 gr. gave 135 c.c. nitrogen (moist) at 12°C and $757·8^{mm} = 33·69$ per cent nitrogen.

The formula $\{Co_2(NH_3)_{10}(NO_2)_2\}\{Co_2(NH_3)_4(NO_2)_8\}_2$ requires 23·79 per cent cobalt, and 33·87 per cent nitrogen. This salt is metameric with the corresponding salt of the octamin series already described, and with Erdmann's salt, $Co_2(NH_3)_6(NO_2)_6$, since we have

$$\{Co_2(NH_3)_{10}(NO_2)_2\}\{Co_2(NH_3)_4(NO_2)_8\}_2 = 3Co_2(NH_3)_6(NO_2)_6.$$

In endeavoring to obtain measurable crystals by allowing a solution of this salt to stand for some time, and evaporate at ordinary temperatures, I found that the salt was partially decomposed, a considerable quantity of cobaltic nitrate being formed.

Oxalate of Xanthocobalt. — In the first part of this memoir, in consequence of an oversight, the formula given for the oxalate of xanthocobalt contains (old style) five atoms of water of crystallization. The salt is really anhydrous, and the analyses given agree with the formula $Co_2(NH_3)_{10}(NO_2)_2(C_2O_4)_2$. The salt is obtained from hot solutions in granular crystals. Its solution in hot dilute nitric acid deposits abundant crystals of the nitrate, the oxalate being almost completely decomposed. Sulphate and nitrate of xanthocobalt may be readily prepared from the oxalate by boiling with a small excess of mercurous sulphate or nitrate, adding, in the first case, a little dilute sulphuric, in the last, a little nitric, acid. As the oxalate can be precipitated by ammonic oxalate from the crude nitrate, this furnishes a cheap and expeditious method of obtaining the pure sulphate.

The formulas of the salts of xanthocobalt at present known become in the new notation: —

Chloride,	$Co_2(NH_3)_{10}(NO_2)_2Cl_4$
Bromide,	$Co_2(NH_3)_{10}(NO_2)_2Br_4$
Iodide,	$Co_2(NH_3)_{10}(NO_2)_2I_4$

Nitrate,	$Co_2(NH_3)_{10}(NO_2)_2(NO_3)_4$
Nitrite,	$Co_2(NH_3)_{10}(NO_2)_2(NO_2)_4 + 4OH_2$
Sulphate,	$Co_2(NH_3)_{10}(NO_2)_2(SO_4)_2$
Iodo-sulphate,	$Co_2(NH_3)_{10}(NO_2)_2(SO_4)I_2 + 2OH_2$
Hyperiodo-sulphate,	$Co_2(NH_3)_{10}(NO_2)_2(SO_4)I_4$
Auro-chloride,	$Co_2(NH_3)_{10}(NO_2)_2Cl_4 + 2AuCl_3 + OH_2$
Platino-chloride,	$Co_2(NH_3)_{10}(NO_2)_2Cl_4 + PtCl_4 + OH_2$
Hydrargo-chloride,	$Co_2(NH_3)_{10}(NO_2)_2Cl_4 + 4HgCl_2 + OH_2$
Oxalate,	$Co_2(NH_3)_{10}(NO_2)_2(C_2O_4)_2$
Chromate,	$Co_2(NH_3)_{10}(NO_2)_2(CrO_4)_2 + 2OH_2$
Dichromate,	$Co_2(NH_3)_{10}(NO_2)_2(Cr_2O_7)_2$
Ammonia-cobalt nitrite,	$\{Co_2(NH_3)_{10}(NO_2)_2\}\{Co_2(NH_3)_4(NO_2)_8\}_2$
Ferrocyanide,	$Co_2(NH_3)_{10}(NO_2)_2(FeCy_6) + 6OH_2$.

I have collected them for the purpose of convenience of reference and comparison.

PURPUREOCOBALT.

12. In the first part of this memoir Genth and I have endeavored to show that purpureocobalt and roseocobalt form two distinct series of salts; that chloride of roseocobalt, for instance, $Co_2(NH_3)_{10}Cl_6 + 2OH_2$, cannot be regarded as differing from chloride of purpureocobalt only by water of crystallization. This view has been adopted by some chemists, rejected and even ridiculed by others. I shall endeavor to show, by a more extended study and comparison of the two series of salts, that they are essentially different, and, furthermore, that, as the theory of these compounds proposed by Blomstrand suggests, there are more than two series containing the group $Co_2(NH_3)_{10}$. Reserving the discussion for the present, I proceed to the description of the salts which serve to throw light upon the question.

Auro-chloride of Purpureocobalt. — When a solution of chloro-aurate of sodium is added to a hot solution of chloride of purpureocobalt, containing a little free chlorhydric acid, no precipitate is formed at first, but after standing a few hours crystals of a new salt are deposited. The crystals in question present flat prismatic forms. They have a dark ruby-red color, with a dull violet lustre, and after standing exhibit a distinct superficial reduction of gold. Of these crystals

0·9028 gr. gave 0·3206 gr. gold, and 1·0560 gr. silver = 35·50 per cent gold, and 38·45 per cent chlorine.

0·6840 gr. gave 0·1896 gr. SO_4Co and 0·2425 gr. gold = 10·55 per cent cobalt, and 35·45 per cent gold.

		Calculated.	Found.	
Cobalt,	2	10·64	10·55	
Gold,	2	35·55	35·50	35·45
Chlorine,	12	38·44	38·45	

In the first analysis the salt was reduced by zinc and dilute sulphuric acid, the gold weighed directly, and the chlorine determined in the filtrate. In the second, the salt was heated with sulphuric acid, and the reduced gold separated from the cobaltic sulphate by dissolving the latter in boiling water. The formula of the salt is

$$Co_2(NH_3)_{10}Cl_6 + 2AuCl_3,$$

or rationally

$$\overset{vi}{Co_2}\begin{cases} NH_3-Cl \\ NH_3-NH_3-Cl \\ NH_3-NH_3-Cl=AuCl_3 \\ NH_3-NH_3-Cl=AuCl_3 \\ NH_3-NH_3-Cl \\ NH_3-Cl \end{cases}$$

From the formula it appears that the salt is unsaturated, similar salts containing four or six molecules of auric chloride being also possible.

Chloro-hydrargyrates of Purpureocobalt. — When mercuric chloride is added in excess to a solution of chloride of purpureocobalt, a rather dull red salt separates in small needles, slightly soluble in cold water, but much more easily soluble in hot water, especially in the presence of free chlorhydric acid, and readily crystallizing from the hot solution. This salt has the formula

$$Co_2(NH_3)_{10}Cl_6 + 6HgCl_2$$

as the following analyses show: —

0·5884 gr. gave 0·3922 gr. Hg_2Cl_2 = 56·60 per cent mercury.
0·4409 gr. gave 0·4025 gr. silver = 30·00 per cent chlorine

		Calculated.	Found.
Mercury,	6	56·47	56·60
Chlorine,	18	30·04	30·00

When the chloride of purpureocobalt is in excess, or when the two chlorides are mixed in the proper atomic proportions, another double salt separates in very beautiful violet-colored prismatic crystals, which, like the last-mentioned salt, are but slightly soluble in cold water, but are much more soluble in boiling water, and crystallize from the solution on cooling. This salt has the formula

$$Co_2(NH_3)_{10}Cl_6 + 4HgCl_2$$

as the following analyses show: —

0·7938 gr. gave 0·4735 gr. Hg_2Cl_2 = 50·65 per cent mercury.
0·3970 gr. gave 0·3771 gr. silver = 31·23 per cent chlorine.
0·9752 gr. gave 0·9356 gr. silver = 31·42 per cent chlorine.
1·3600 gr. gave 0·1024 gr. cobalt = 7·52 per cent cobalt.

		Calculated.	Found.
Mercury,	4	50·47	50·65
Chlorine,	14	31·35	31·23 31·42
Cobalt,	2	7·44	7·52

On Blomstrand's view the formulas of the two mercury salts may be written

$$\overset{vi}{Co_2}\begin{cases} NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-Cl=HgCl_2 \end{cases} \qquad \overset{vi}{Co_2}\begin{cases} NH_3-Cl \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-NH_3-Cl=HgCl_2 \\ NH_3-Cl \end{cases}$$

It is possible that the salt containing six atoms of mercury belongs to the roseocobalt series, as I find that it is formed when a solution of $HgCl_3Na$ is added to one of the soluble sulphate of roseocobalt, $Co_2(NH_3)_{10}(SO_4)_3 + 5Aq$, which I shall describe farther on. I may also remark that if the progress of science should make us acquainted with a method of determining cobalt in these salts with precision, they would enable us to determine the atomic weight of that metal with great accuracy, the first salt containing 5·54, and the second 7·44 per cent of cobalt, so that a relatively large error in the weight of $(NH_3)_{10}Hg_6Cl_{18}$, or of $(NH_3)_{10}Hg_4Cl_{14}$, would exert an inappreciable influence on the result. If we regard the salt $Co_2(NH_3)_{10}Cl_6 + 4HgCl_2$ as unsaturated, it ought to combine with other electro-negative chlorides to form salts with three metallic elements. I have not, however, found this to be the case, so far, at least, as the chlorides of gold and platinum are concerned.

In analyzing these salts, I found it most advantageous to determine the mercury in the form of calomel, by dissolving the salt in water, adding a little chlorhydric acid, and then reducing the mercuric to mercurous chloride by a solution of sodic hypophosphite, the solution of mercuric salt having the temperature of 40° C. The mercurous chloride was then weighed on a porous earthenware cone at 100° C. In determining chlorine it is best to dissolve the salt in hot water, with a little free sulphuric acid. The mercury may then be separated as

HgS, and the chlorine determined in the filtrate after removing the excess of SH_2 by a solution of ferric alum.

Antimonio-chloride of Purpureocobalt. — A solution of antimonious chloride added to one of chloride of purpureocobalt gives a precipitate of small, granular, dull violet-red crystals. These may be washed with strong chlorhydric acid and dried by pressure between folds of porous paper, and afterward at 100° C. Water decomposes it readily, with precipitation of SbOCl. The formula of this salt is

$$Co_2(NH_3)_{10}Cl_6 + SbCl_3,$$

as appears from the following analyses: —

0·8100 gr. gave 0·3402 gr. SO_4Co = 15·99 per cent cobalt.
0·6500 gr. gave 0·1370 gr. SbO_2 = 16·64 per cent antimony.

The formula requires 16·22 per cent cobalt, and 16·49 per cent antimony.

Bismuthous chloride gives a lilac red precipitate in solutions of chloride of purpureocobalt, insoluble in strong chlorhydric acid, and readily decomposed by water with precipitation of BiOCl.

Neutral Chromate. — When a solution of nitrate of purpureocobalt is added to one of neutral potassic chromate, a red crystalline precipitate is formed, which, after washing with cold water, may be dissolved in boiling water, with addition of a few drops of acetic acid. After some hours the neutral chromate separates in crystals, which have a peculiar red color with bronze-yellow reflections. The crystals are thin, acicular leaves. The salt dissolves rather easily in hot water, but the solution is soon more or less decomposed, unless free acid is present. The dilute solution is orange-yellow; concentrated solutions are red. The dried salt somewhat resembles litharge. Different preparations of this salt gave, on analysis, results which differed somewhat from each other, but only in the amount of water of crystallization. In one preparation

0·2637 gr. gave 0·2480 gr. CrO_4Ba = 43·17 per cent CrO_4
0·3651 gr. gave 0·0811 gr. cobalt = 22·21 per cent.
0·3598 gr. gave 0·0058 gr. water up to 170° C. = 1·61 per cent.

I consider the loss of weight on heating to arise partly from hygroscopic moisture, and partly from slight decomposition, and believe that the salt is really anhydrous. The formula

$$Co_2(NH_3)_{10}.O.(CrO_4)_2$$

requires cobalt, 21·99 per cent, and CrO_4, 43·32 per cent. The formation of the neutral chromate is expressed by the equation: —

$$Co_2(NH_3)_{10}(NO_3)_6 + 2CrO_4K_2 + OH_2 = Co_2(NH_3)_{10}.O.(CrO_4)_2 + 4KNO_3 + 2NO_3H.$$

The nitric acid set free dissolves a portion of the chromate forming the dichromate, which remains in solution. When a solution of neutral potassic tungstate, WO_4K_2, is digested with dry neutral nitrate of purpureocobalt, a pink tungstate of purpureocobalt is formed, and the liquid then gives a strong acid reaction with litmus. The reaction is probably the same as that given above for the chromate.

Potassic iodide gives a dull red crystalline precipitate with neutral chromate of purpureocobalt in solution. The analyses of this salt led to no definite formula, and the precipitate appeared to be a mixture of the chromate described, $Co_2(NH_3)_{10}.O.(CrO_4)_2$, and the iodo-chromate, $Co_2(NH_3)_{10}I_2(CrO_4)_2$. By digesting powdered chloride of purpureocobalt with neutral potassic chromate, Braun obtained a dark brown-red powder, to which he gives the formula $Co_2(NH_3)_{10}(CrO_4)_3$. According to the same writer, when powdered chloride of purpureocobalt is added, in small portions at a time, to a concentrated solution of potassic dichromate, a beautiful crystalline powder is formed, which has also the formula $Co_2(NH_3)_{10}(CrO_4)_3$. In this case chromic acid, CrO_4H_2, must be set free. When a solution of potassic chromate is added to one of chloride of purpureocobalt, the crystalline precipitate formed, according to my observations, always contains chlorine. My analyses led, however, in this case also, to no definite formula, but pointed to a mixture of the chromate $Co_2(NH_3)_{10}.O.(CrO_4)_2$, and the chloro-chromate, $Co_2(NH_3)_{10}Cl_2(CrO_4)_2$. Braun has also described a salt to which he gives the formula $2NH_3.Co_2O_3.3CrO_3 + 2NH_4Cl$, which I should write $Co_2(NH_3)_2(CrO_4)_3 + 2NH_4Cl$, but the analyses are incomplete without a determination either of ammonia or of nitrogen.

Dichromate. — A solution of potassic dichromate gives, with one of nitrate of purpureocobalt, a granular red precipitate, which may be recrystallized by solution in boiling water, to which a little acetic acid has been added. The salt then separates in small, indistinct crystals of a dark brick-red color, with bronze reflections. It is somewhat soluble in cold, and dissolves readily in boiling, water. Of this salt

0·6031 gr. gave 0·0747 gr. cobalt = 12·38 per cent.

0·7101 gr. gave 1·1252 gr. CrO_4Ba = 67·71 per cent. (Chromium = 52·2)

0·6295 gr. lost, at 105° C., 0·0077 gr. water = 1·22 per cent; at 120° C., 0·0118 gr. = 1·87 per cent; and at 133° C., 0.0166 gr. = 2·64 per cent.

At 133° C. the salt was slightly decomposed. Between 133° and 145° C. it lost 4·46 per cent with partial decomposition. These analyses correspond to the formula $Co_2(NH_3)_{10}(Cr_2O_7)_3 + OH_2$.

		Calculated.	Found.
Cobalt,	2	12·35	12·38
Cr_2O_7,	3	67·97	67·71
Water,	1	1·88	1·87

The salt was dried for two weeks *in pleno* over sulphuric acid. In preparing nitrate of purpureocobalt by Mr. Mills's process, in which an ammoniacal solution of cobaltic nitrate is oxidized by potassic dichromate, I obtained, besides the nitrate, a large quantity of beautiful orange-red crystalline scales, with gold reflections. The crystals were easily purified by recrystallization. They are readily soluble in hot water, and crystallize from the solution almost completely on cooling. The formula of this salt is $Co_2(NH_3)_{10}(Cr_2O_7)_3 + 5OH_2$, as the following analyses show: —

0·6366 gr. gave 0·0735 gr. cobalt = 11·54 per cent.

0·6447 gr. gave 0·2888 gr. CrO_3 = 63·31 per cent Cr_2O_7.

0·1740 gr. gave, up to 139° C., 0·0125 gr. water = 7·19 per cent.

0·0800 gr. gave, up to 145° C., 0·0082 gr. water = 10·25 per cent.

Mean, 8·72 per cent.

In the last water determination the salt was slightly decomposed. The formula requires

		Calculated.	Found.
Cobalt,	2	11·48	11·54
Cr_2O_7	3	63·20	63·31
Water	5	8.76	8·72 (mean.)

The difference in appearance and in the number of atoms of water in the dichromate of purpureocobalt may possibly arise from the fact that, in one case, a solution of the nitrate of purpureocobalt was poured into one of potassic dichromate in excess; in the other, the nitrate was presented to the dichromate as fast as formed, — in some sense in the nascent state. But it is singular that the two hydrates are not the

same after recrystallization. A solution of potassic dichromate gives, with one of chloride of purpureocobalt, a dark red crystalline precipitate, the analyses of which pointed to a mixture of $Co_2(NH_3)_{10}(Cr_2O_7)_3$ and $Co_2(NH_3)_{10}.Cl_2(Cr_2O_7)_2$. I did not succeed in obtaining the basic dichromate $Co_2(NH_3)_{10}.O.(Cr_2O_7)_2$. In all the chromates of the cobaltamines which I have studied, the direct determination of the water of crystallization has been effected with peculiar difficulty, in consequence of the tenacity with which these salts retain water up to temperatures very near to those at which incipient decomposition occurs.

(*To be continued.*)

II.

CONTRIBUTIONS TO THE BOTANY OF NORTH AMERICA.

(*Continued from Vol. IX., p. 218.*)

BY ASA GRAY.

Presented, May 12 and Oct. 13, 1874.

I. *A Synopsis of the North American Thistles.*

CNICUS Linn., Schreber, Benth. & Hook.

(CIRSIUM Tourn., DC.)

1. *Species Inquilinæ.*

C. LANCEOLATUS Hoffm. Folia decurrentia, superne setoso-aspera.
C. ARVENSIS Hoffm. Capitula subdioica, parva.

2. *Species Indigenæ.*

§ 1. Involucrum gradatim imbricatum; squamis adpressis, exterioribus sensim brevioribus, omnibus nec herbaceo- nec scarioso-appendiculatis, intimis in paucis appendice parva scariosa superatis.

* Folia viridia seu araneoso-lanata (nunquam tomento denso albo-lanuginosa): caules sæpius abbreviati vel simplices: involucri squamæ laxiusculæ, planæ, subchartaceæ, exteriores mucrone vel spinula nec valido nec patente superatæ: antherarum appendices acuminatæ vel cuspidatæ.

+– Atlantici; capitulis mediocribus angustioribus; pedunculis nudis.

C. REPANDUS Ell. *Cirsium repandum* Michx. Humilis, involucro campanulato.

C. LECONTEI. *Cirsium Lecontei* Torr. & Gray, Fl. 2, p. 459. Elatior, involucro oblongo vel cylindraceo.

+– +– Atlantici; capitulis majoribus latis bracteis spinosis nunc stipatis.

C. PUMILUS Torr. *Cirsium pumilum* Spreng., Torr. & Gray, l. c. cum syn. Capitulo maximo sæpe nudo; involucri squamis exterioribus latiusculis spinula brevi armatis, intimis appendice parva scariosa erosa quandoque superatis.

C. HORRIDULUS Pursh. *Cirsium horridulum* Michx., Torr. & Gray, l. c. cum syn. Capitulis singulis involucro exteriori bractearum spinosissimarum cinctis; squamis involucri proprii attenuatis innocuis.

+ + + Boreali-occidentales; involucri squamis intimis nonnullis apice pl. m. scarioso-appendiculatis modo *C. humilis*.

C. FOLIOSUS. *Carduus foliosus* Hook. Fl. *Cirsium foliosum* DC. Araneoso-lanatus et longe villosus, demum glabrescens; caule valido subpedali crebre folioso; capitulis sessilibus majusculis inter folia glomeratis bracteisque spinosissimis stipatis; involucro et corollis fere *C. Drummondii;* foliis elongatis suberectis spinoso-dentatis vel pinnatifidis. — Prairies of the northern Rocky Mountains, Drummond (a less prickly form), Burke (in herb. Hook.): high pine country in the interior of Oregon, Spalding. Intermediate in appearance and character between *C. Drummondii* and *C. eriocephalus*, but near the former. Involucre broad, an inch high, glabrate, at first with some fine cobwebby wool, but no jointed hairs; the outer scales broadish, successively shorter, appressed, rather abruptly tipped with a short and weak prickle.

C. DRUMMONDII. *Cirsium Drummondii* Torr. & Gray, Fl. cum syn. Planta typica tripollicaris ad tripedalem! Capitulis solitariis vel subplurimis magnis; involucri squamis exterioribus oblongo-lanceolatis sensim in cuspidem vel spinulam fere innocuam acuminatis, intimis fere linearibus sæpissime appendicula scariosa superatis; corollis sesquipollicaribus (tubo proprio tenui pollicari), lobis fauce brevioribus; foliis subpinnatifidis. — From Mackenzie River near the arctic circle to the Colorado Rocky Mountains and Oregon. In British Columbia Dr. Lyall collected specimens fully four feet high.

Var. ACAULESCENS, capitulis inter folia radicalia sessilibus aut paullo aut dimidio minoribus, corollis nunc parum pollicaribus. *Cirsium acaule* var. *Americanum* Gray in Proc. Acad. Philad. 1863, p. 68. *C. Drummondii* var. Eaton in Bot. King, p. 195. — Rocky Mountains, and sparingly in the Sierra Nevada of California.

C. QUERCETORUM. Leviter araneosus, glabrescens; caule subpedali ramoso oligocephalo; foliis sub-bipinnatifidis vel pinnatipartitis lobis sæpe 2–5-fidis; involucri squamis crasso-coriaceis, exterioribus ovali-oblongis ad lanceolatas mucrone vel spinula rigida apiculatis, intimis

parum scarioso-appendiculatis; corollæ hinc profundius fissæ lobis fauci æquilongis unico longiore. — Hills at Oakland and elsewhere near San Francisco, California, Bolander, Kellogg. Variable as *C. Drummondii* is, I am unwilling to include in it the plant here described.

* * Folia laxe araneosa demum denudata: appendices antherarum acutatæ: caules elati sæpius ultra-orgyales, ramis laxis gracilibus: capitula pedunculata nuda: involucri subglobosi squamæ arcte imbricatæ, muticæ vel mucronatæ, pleræque dorso versus apicem carinato-incrassato viscidæ.

+ Folia nunquam decurrentia, matura præter tomentum tenue mox deciduum pl. m. pilosa.

C. MUTICUS Pursh. *Cirsium muticum* Michx.; Torr. & Gray, Fl. cum syn. Involucrum primum arachnoideum, squamis muticis vel mucronulatis. — Newfoundland and Saskatchawan to Florida and Louisiana.

C. NUTTALLII. *Cnicus glaber* Ell., vix *Carduus* (*Cnicus*) *glaber* Nutt. Gen. *Cirsium Nuttallii* DC. Prodr. 6, p. 651; Chapm. Fl. p. 247. Gracilis; capitulis quam præcedentis minoribus; involucro haud arachnoideo, squamis angustioribus, exterioribus spinula parva setacea demum patente superatis. — South Carolina to Florida. Nuttall's New Jersey plant is without much doubt *C. muticus*, and he was probably unacquainted with the present species, — for which, however, it is not worth while to coin a new specific name.

+ + Folia in caulem pl. m. decurrentia, præter tomentum araneosum laxum tardius deciduum glabra.

C. WRIGHTII. *Cirsium Wrightii* Gray, Pl. Wright. 2, p. 101. — Western Texas and New Mexico, C. Wright.

* * * Folia subtus vel utrinque tomento denso albo-lanata: appendices antherarum acutatæ vel cuspidatæ: involucri subglobosi squamæ crebræ arcte imbricatæ, rigidæ, pleræque spinula sæpius tenui demum patente superatæ, dorso versus apicem nervo seu lineola carinali incrassata sæpe viscidula notatæ.

+ *Discolores* (nempe foliis supra viridibus), orientales, floribus roseo-purpureis (raro albis).

++ Pedalis ad tripedalem; capitulis parvulis; spinulis involucri brevissimis debilibus.

C. VIRGINIANUS Pursh. *Carduus Virginianus* Linn. — Virginia and Kentucky to Texas.

++ ++ Orgyales et ultra; capitulis mediocribus; spinulis involucri aristiformibus debilibus.

C. ALTISSIMUS Willd. *Carduus altissimus* Linn. *Cirsium diversifolium* DC. Folia caulina subintegra vel subpinnatifida. — Pennsylvania and Wisconsin to Louisiana.

C. DISCOLOR Muhl. in Willd. Folia profunde pinnatifida segmentis angustis. — Canada to Illinois and southward along the upper country.

+ + *Subconcolores boreales;* foliis fere pinnatisectis, segmentis linearibus elongatis.

C. PITCHERI Torr. in Eaton, Man. Bot. *Cirsium Pitcheri* Torr. & Gray. *C. Hookerianum* var. Gray in Stevens, Rep. Pac. R. R. 12, p. 45. — Sandy shore of Lake Superior and (recently) of Lake Michigan. Also Montana Territory, Dr. Suckley.

+ + + *Subconcolores occidentales;* foliis subintegris vel pinnatifidis, junioribus saltem pagina superiore arachnoideo-dealbatis, maturis quandoque glabratis.

++ Antherarum appendices cuspidato-acuminatæ: caulis pedalis, raro 2–3-pedalis.

C. UNDULATUS. *Carduus (Cnicus) undulatus* Nutt. Gen. *C. discolor* Hook. Fl. Bor.-Am. pro parte. *Cirsium undulatum* Spreng.; Torr. & Gray, Fl. *C. Douglasii* DC. Prodr. 6, p. 643; Nutt. l. c. *C. Hookerianum*, Hook. Lond. Jour. Bot. 6, p. 253, non Nutt. — An exceedingly variable species, widely diffused from the Upper Mississippi and Saskatchawan region to the Pacific in Oregon, and south to Texas and New Mexico, usually with reddish-purple or occasionally pale flesh-colored or white flowers, differing much in the size of the heads, also in the foliage and in the prickles of the involucre.

Var. CANESCENS (*Cirsium canescens* Nutt. in Trans. Amer. Phil. Soc. l. c. & *C. undulatum* β. Torr. & Gray) — capitulis vix ultrapollicaribus — is the more depauperate form of the northern and western plains. *Cirsium brevifolium* Nutt. l. c. is the form with less pinnatifid or almost entire leaves.

Var. MEGACEPHALUS: capitulis 2–2½-pollicaribus; involucri squamis latioribus dorso planis spinula brevi vel brevissima cuspidatis. — This large-headed form prevails in Texas, &c., but we have it from Minnesota (Geyer), and from the waters of the Columbia River (Spalding, Lyall); and between these two forms most of the specimens are intermediate. They also pass into the

Var. OCHROCENTRUS (*Cirsium ochrocentrum* Gray, Pl. Fendl.): foliis profunde pinnatifidis, lobis squamisque involucri spinis ochraceis longioribus armatis.—W. Texas and New Mexico to the Sierra Nevada, California. A most marked variety, which may reclaim a specific rank.

Var. GRAHAMI: formæ *megacephalæ* accedens, elatior; foliis submembranaceis superne mox glabratis; involucri squamis exterioribus spinula brevissima cuspidatis, interioribus extus minute scaberulis margine scabro-ciliolatis; floribus sanguineo-purpureis. *Cirsium Grahami* Gray, Pl. Wright. 2, p. 102; Hook. Bot. Mag. t. 5885.—Arizona, C. Wright, Thurber, &c., in low grounds, to which its greater height, softer and greener less prickly leaves, &c., may be attributed.

++ ++ Antherarum appendices apice deltoideo parum acuto.

C. BREWERI. Orgyalis ad 10-pedalem; foliis elongatis pinnatifidis cauleque lana adpressa undique incanis, lobis brevibus angustis spinosis; capitulis parvulis paniculatis brevissime pedunculatis; involucri globosi primum araneosi squamis arcte imbricatis, exterioribus oblongis lanceolatisque coriaceis, apice viridi-notato viscidulo spinula gracile patente abrupte superato; corollis purpureis nunc ochroleucis, lobis fauce brevioribus; styli nodo sub parte stigmatifera filiformi manifesto.—California, mostly in wet ground, Strawberry Valley near Mt. Shasta, Brewer; Humboldt and Mendocino Counties, Bolander, Kellogg, and Harford (coll. no. 557, 562, 563); borders of Nevada near Carson, Anderson; also, a somewhat less woolly form, in a cañon of the San Juan Mountains, Monterey County, Brewer! Heads several or numerous in a branching panicle, an inch or less in height. Corolla with one lobe more or less shorter than the throat, the other four much more united.—This, being a Californian species, might be taken for *Cirsium Douglasii* DC., but it is not found in Douglas's collections. The specimen on which De Candolle established his species was doubtless from Columbia River near the coast; it is the plant referred by Hooker to *Carduus discolor*, and is the same as Nuttall's *Cirsium Hookerianum*, *i.e.* the *Cnicus undulatus*. The present species appears to have been first collected by Professor Brewer, whose name it may bear.

* * * * Folia subtus saltem albo-lanata: appendices antherarum apice deltoideo parum acuto: involucri oblongi nunc cylindraceo-campanulati; squamæ minus crebræ, laxiuscule imbricatæ, tenuiores minus inæquales, in spinulam rectam vel cuspidem attenuatæ: corollæ sanguineæ. Capitula speciosa, sesqui–bipollicaria.

C. ARIZONICUS. Albo-lanatus; caule 2–4-pedali ramoso folioso; foliis pectinato-pinnatifidis dentatisve spinosis; capitulis brevi-pedunculatis vel subsessilibus; involucri squamis extimis ovato-oblongis, sequentibusque lanceolatis in acumen spina breviuscula superatum angustatis; corollæ lobis fauce duplo longioribus; antherarum appendicibus fere obtusis; styli appendice stigmatica supra nodum prominulum brevi! *Cirsium undulatum* var. Gray, Pl. Wright. 2, p. 101.— Arizona and S. Utah, C. Wright, Thurber, Palmer, Loew, Mrs. Thompson, Parry. By the involucre, &c., related on the one hand to the *C. undulatus* var. *ochrocentrus*, on the other to the following species. Remarkable as being the only indigenous species of the United States with a short stigmatic tip to the style, this being barely 4 to 6 times longer than thick, and the node at its base manifest.*

C. ANDERSONII. Minus lanatus; caule bi–tripedali gracili parcius foliato; capitulis longius pedunculatis; involucri squamis laxioribus angustioribus plerisque e basi lanceolata sensim subulato-attenuatis spinula brevissima cuspidatis, intimis tenuibus; corollæ lobis fauci subæquilongis; styli appendice filiformi longiuscula, nodo evanido.— Sierra Nevada, California, and adjacent part of Nevada, Anderson, Torrey, Bolander, &c. Head broader and rather larger than that of the foregoing species. Tips of the anther-appendages deltoid and acute, or in one specimen about as blunt as in *C. Arizonicus*. Additional specimens will show if this be a subsexual difference.

§ 2. Involucrum laxius imbricatum; squamis subæqualibus (extimisve paullo brevioribus) superne subherbaceo-attenuatis vel in acumen sæpius spinescentem patulum sensim productis.

* Mollissime denseque albo-lanati, megacephali: involucri globosi squamæ multiseriales rigidæ, e basi coriacea appressa longe spines-

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* The great-headed Mexican species, with outer reflexed or spreading scales to the involucre spinulose along the margins near the base, have abbreviated tips to the style, and obtuse or merely acute anther-tips.

CNICUS CERNUUS (*Cirsium cernuum* Lag.; at least Linden's no. 1280 and Liebmann's no. 689), which is probably also *C. nivalis* HBK., has very obtuse anther-tips. *Cirsium subcoriaceum* Schult. Bip. (Seemann's no. 2040) seems to differ only in its smaller head and less spreading involucral scales, and may be only a variety.

CNICUS HETEROLEPIS (*Cirsium heterolepis* Benth. Pl. Hartw., or at least Coulter's no. 467, and apparently Barclay's plant from Tepic, in Beechey's voyage) is very like *C. cernuus*, but has acute anther-tips. Perhaps there is some dimorphism.

centi-attenuatæ, patentes: corollæ lobi fauce sesqui vel duplo longiores. Capitula nuda, subsolitaria, sæpius bipollicaria.

C. OCCIDENTALIS. Caule sæpius valido 2–5-pedali; foliis subpinnatifidis sinuatisve spinulis parvulis armatis superne nunc denudatis; involucri primum lanosissimi squamis in appendicem spinescentem longe sensim attenuatis; corollis sanguineo-purpureis æqualiter 5-fidis; antherarum appendicibus acuminatis; stylo haud nodoso nudo, appendice breviusculo. *Carduus occidentalis* Nutt. in Trans. Am. Phil. Soc. n. ser. 7, p. 418, cum char. pess. *Cirsium Coulteri* Gray, Pl. Fendl. p. 110. — Rather common throughout California, especially in the western part of the State, but extending into the borders of Nevada. Apparently only seeds were collected by Douglas, from which it was raised in the London Horticultural Society's garden in 1837. It was sparingly collected by Coulter and Nuttall, and since by most recent collectors. The heads vary in size, in some specimens being little over an inch in length.

C. NEO-MEXICANUS. Magis spinosus; involucri squamis e basi sæpius latiore in appendicem lanceolato-subulatam spina validiore superatam productis, exterioribus plerumque reflexis; corollis pallidis subinæqualiter 5-fidis; antherarum appendicibus tenuiter cuspidatis; styli appendice stigmatica elongata filiformi nodo sæpius manifesto stipata. *Cirsium Neo-Mexicanum* Gray, Pl. Wright. 2, p. 101. — New Mexico, Fendler, Wright, Thurber, &c.

* * Lana laxiore vel tenuiore araneosa canescentes, nunc glabriores vel denudati virides. Capitula sæpius paniculata, subracemosa, vel conglomerata, pollicaria ad sesquipollicarem.

+ Involucri squamæ rigidiores spinula aciculari pungentes: flores albi vel flavescentes.

++ Corollæ limbo æqualiter alte 5-fido, lobis fauce duplo longioribus.

C. ANDREWSII. Ut videtur elatus, ramosus, lana laxa decidua glabrescens; capitulis ultrapollicaribus ramos foliatos terminantibus; involucro primum arachnoideo-lanosissimo; squamis e basi coriacea oblonga vel lanceolata plerisque in appendicem subulato-acerosam productis; antherarum appendicibus deltoideo-acutatis. — California, Dr. Andrews. I have seen only a single specimen, collected probably not very far from San Francisco or Sacramento: so that the species needs confirmation. The corolla is hardly an inch long; its lobes 3 or 4 lines long, but the throat of only half their length, in which respect it is unlike any other species of this division.

++ ++ Corollæ limbo inæqualiter vel subæqualiter 5-fido, lobis fauce pl. m. brevioribus: folia subtus lana araneosa sæpissime dealbata, supra glabrescentia.

C. CALIFORNICUS. Suborgyalis; capitulis solitariis vel paucis nudis; involucro tenuiter lanato mox glabrato, squamis in appendicem subulatam patulam sæpius validam productis; floribus albis vel ochroleucis. *Cirsium Californicum* Gray in Bot. Whipp. p. 56. — California, from Stanislaus River (Bigelow) and Santa Clara Co. (Brewer) to near San Diego (Cooper); and some forms of it apparently on the frontiers of Nevada. *Cirsium foliosum* Eaton in Bot. King, as to Watson's specimens, is probably a form of this species; but the corollas are said to be purplish.

C. HOOKERIANUS. Caule 1–3-pedali ad apicem folioso; capitulis subsolitariis vel glomeratis majusculis sæpius folioso-bracteatis; involucro valde arachnoideo-lanoso subviscoso (rarius glabrato); squamis aceroso-attenuatis; floribus albis. *Carduus discolor*, var. β. floribus albis, Hook. Fl. Bor.-Am. 1, p. 302. *Cirsium Hookerianum* Nutt. in Trans. Amer. Phil. Soc. l. c. p. 418. — Rocky Mountains, chiefly north of lat. 48°, and in the upper wooded and alpine regions, Drummond, Burke, Bourgeau (herb. Hook.). Nuttall founded *Cirsium Hookerianum* wholly upon a Drummondian specimen (communicated by Sir Wm. Hooker to Schweinitz) of the *Carduus discolor* var. β. of the Flora Boreali-Americana. All the other north-western specimens referred to *C. discolor* belong to *C. undulatus*, from which the present species is wholly distinct. Besides the long and cobwebby wool, the long tips of the scales of the involucre generally have some viscid pubescence, and occasionally some coarser many-jointed hairs, approaching those of the following species.

C. ERIOCEPHALUS. Caule 1–2-pedali simplici creberrime folioso; foliis linearibus multilobatis plerumque longe decurrentibus spinosissimis; capitulis parvulis in glomerulum foliosum primum nutans arcte congestis; involucro pilis longis multi-articulatis fuscis lanosissimo, squamis arrectis acerosis (basi parva dilatata excepta); floribus "luteis" vel luteolis. *Cirsium eriocephalum* Gray in Proc. Acad. Philad. 1863, p. 69; Eaton in Bot. King, p. 196. — High alpine region of the Rocky Mountains in Colorado, Parry, Hall and Harbour, Vasey, Greene, &c. Varies with herbage and involucre glabrate, perhaps passing into var. *leiocephalus* Eaton, l. c.; but Watson's specimens, from the Uinta Mountains, are insufficiently developed and still very doubtful. The species is nearly related to the foregoing.

+ + Involucri squamæ tenuiores laxiores, fere innocuæ: caules 3–8-pedales: capitula nuda.

C. EDULIS. Laxe tenuiter araneosus, mox glabrescens viridis; caule folioso; foliis sæpius sinuato-pinnatifidis membranaceis; capitulis subpaniculatis vel subglomeratis; involucro arachnoideo; corollis purpureis (quandoque pallidis?) gracilibus subinæqualiter 5-fidis, lobis demum filiformibus incrassato-apiculatis. *Cirsium edule* Nutt. l. c. — From British Columbia southward along the coast of California to the Bay of San Francisco. Filaments sometimes hairy, as described by Nuttall, very commonly glabrous: perhaps a subsexual difference. Dwarf specimens collected by Lyall in the northern Cascade Mountains have the leaves pinnately parted into narrow divisions.

C. REMOTIFOLIUS. Caule sæpius parce foliato; capitulis subpaniculatis; foliis subtus araneoso-dealbatis raro denudatis pinnatipartitis, lobis angustis; involucro tenuiter arachnoideo glabrescente, squamis lineari-attenuatis; corollis ochroleucis inæqualiter 5-fidis, lobis 3 vel 4 altius coalitis. *Carduus remotifolius* Hook. l. c. *Cirsium remotifolium* DC. *C. stenolepidum* Nutt. l. c. — Oregon near the coast to Humboldt Co., California.

§ 3. Involucrum subglobosum gradatim imbricatum, squamis plerisque scarioso- vel fimbriato-appendiculatis: flores albidi vel flaviduli. (*Echenais* Cass., DC.)

C. PARRYI. Viridis, vix araneosus; capitulis subracemosis parum nutantibus; foliis lanceolatis sinuato-dentatis; involucro laxius imbricato; squamis subchartaceis, exterioribus paullo brevioribus linearibus seu lanceolatis, marginibus superne tenuiter scariosis pectinato-fimbriatis ciliatisque, intimis appendice scariosa lacera parva superatis; corollis flavidis, lobis fauce longioribus. — Rocky Mountains of Colorado Territory, at the elevation of 8–9,000 feet, coll. Parry (no. 34), and Hall and Harbour (no. 340), which I had doubtfully referred to *Cirsium edule* in the account of their collections: also Vasey, no. 350, referred to *Echenais carlinoides*, and Wolf and Rothrock, no. 460. Hall and Harbour's no. 341 is probably a hybrid of this with *C. eriocephalus*. In foliage this resembles *C.* (*Echenais*) *Sieversii*. In the involucre, &c., this species and some forms of the next offer a complete transition between *Echenais* and the foregoing section, and they seem to be further connected by hybrids or by variations. The delicate fringe of the outer involucral scales is usually pectinately dissected into almost setiform divisions, often passing into or mixed with long and soft jointed

hairs; the terminal prickle weak. Subtending bracts spiny-ciliate, the inner passing into the involucral scales.

C. CARLINOIDES Schrank, var. AMERICANUS. — Rocky Mountains of Colorado Territory, Hall and Harbour (no. 342), E. L. Greene; Western part of California, Samuels, Bolander: forms with short and broad scarious and lacerate appendages to most of the scales of the involucre, tipped with an extremely short prickle, and few or no prickly-fringed subtending bracts. Also, Mendocino Co., California, Kellogg, a form with exterior involucral scales hardly at all appendaged, and the inner with rather small acuminate appendage, — possibly a hybrid with *C. remotifolius*. This, or a form like it, appears to be *Cirsium scariosum* Nutt. in Trans. Amer. Phil. Soc. l. c. p. 420, from the plains of the Rocky Mountains, — which was accidentally omitted from the Flora of North America.

II. *Notes on Borraginaceæ.*

COLDENIA Linn. Upon a revision of the plants of this group, I am the more convinced that the genus *Coldenia* should have the extension which I proposed in Proc. Am. Acad. 5, p. 340, and should include *Ptilocalyx* Torr. also. And it is pleasant to note that a genus which was dedicated to one of our worthies of the colonial period, has proved to be mainly American, although founded on an Indian plant. The section which I proposed, under the name of *Tiquiliopsis*, if strengthened on the one hand by a second species (*C. Palmeri* Gray, Proc. Am. Acad. 8, p. 136) as respects the coralline appendages, is invalidated on the other by the discovery that its embryo does not accord with that of *T. Nuttallii*; but it is still unlike that of *Tiquilia*. Mr. Watson, in redescribing the *T. Palmeri* (in Bot. King, p. 247), states that the tube of the corolla is "without scales at the base." There are not, indeed, such free scales as those of *T. Nuttallii*, but in their stead are much longer and salient plicæ, reaching up to the insertion of the slender filaments. The fruit, which Mr. Watson first made known, he describes as of "a single obovate-globose smooth nutlet, attached at the base, and without ventral sulcus." There are often two such nutlets matured; but the rounded scar is ventral, not basal, yet very different from that of *T. Nuttallii*. Of albumen there is barely a trace. The character "cotyledons rounded, flat, entire, incumbent upon the shorter radicle," is correct, except that they are rather hemispherical than flat. This turning up of the rather long radicle upon the back

of one of the thick cotyledons is most peculiar and remarkable, and is strikingly in contrast with the deeply hippocrepiform cotyledons of *T. Nuttallii*, surrounding the radicle, as represented in Dr. Torrey's plate. I am disposed to keep up the section *Tiquiliopsis* for these two species with anomalous embryos and appendaged corolla-tube.

HELIOTROPIEÆ Fresenius. The proper stigma in *Heliotropium* and *Tournefortia*, occupying the margin of an annular or peltate disk, and surmounted by an appendage which has generally been taken for stigma, recalls the similar structure in *Apocynaceæ*.

HELIOTROPIUM Tourn.* If three genera are to be admitted in the

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* The North American species as now known are: —

§ 1. EUPLOCA. Vide supra.

H. CONVOLVULACEUM Gray, l. c.

§ 2. EUHELIOTROPIUM. *Heliotropium* & *Schleidenia* (Endl.) Fresenius.

* *Orthostachys* R. Br. (*Presloea* Mart.). *Schleidenia* Endl., Fresenius.

+ Appendix stigmatis elongata, subulata. Folia angusto-linearia.

H. GREGGII Torr. Bot. Mex. Bound. p. 187. Corolla limbo amplo: stylus brevissimus.

H. ANGUSTIFOLIUM Torr. l. c. Corolla lobis ovato-lanceolatis: stylus gracilis.

H. TENELLUM Torr. l. c. Calyx inæqualis: stylus perbrevis.

+ + Appendix stigmatis brevis conica.

H. LIMBATUM Benth., var. CONFERTIFOLIUM Torr. Bot. Mex. Bound. Hartweg's plant, on which *H. limbatum* was founded, has the aspect rather of *H. hispidum* than of Torrey's plant of our Mexican border, collected by Berlandier, Gregg, Wright, &c. But Coulter's no. 1051, and corresponding specimens by Dr. Edwards, &c., are intermediate. This var. *confertifolium* Torr. is very like *H. microphyllum* Swartz., as represented by Wright's Cuban no. 3189. This, however, has a much smaller corolla and a shorter style; and *H. imbricatum* Griseb. would seem to be a form of it.

H. POLYPHYLLUM Lehm. Asper. & Ic. t. 8. *H. glomeratum* A. DC? *H. bursiferum* C. Wright in Griseb. Cat. Cub. p. 211. Florida, Buckley, &c.

Var. LEAVENWORTHII (*H. Leavenworthii* Torr. herb.) is a strict and slender-leaved form; but specimens recently collected by Dr. Edward Palmer, in the same part of Florida where Dr. Leavenworth collected it, seem to have golden-yellow flowers!

H. PHYLLOSTACHYUM Torr. l. c. 1859. *H. myosotoides* Chapm. Fl. p. 330, 1860. Berlandier's numbers 1538, 3038, referred to this species by Dr. Torrey, are more probably depauperate states of *H. hispidum* HBK.

* * Flores ebracteati in spicis scorpioideis sæpius conjugatis vel 1–2-furcatis: antheræ liberæ.

H. EUROPÆUM Linn. Stigma appendice tenuiter subulata superatum. Naturalized southward.

manner and upon the characters proposed by Fresenius in the Flora Brasiliensis, Nuttall's name of *Euploca* would by right of priority take the place of *Schleidenia.* But, in retaining the comprehensive *Heliotropium* of Linnæus (*Piptoclaina* of Don perhaps separated), I prefer to include *Schleidenia*, and also Bentham's section *Platygyne*, in *Euheliotropium*, and to make of *Euploca* a primary section. It is characterized by the long filiform style, strongly penicillate appendage to the stigma, and didymous fruit, which separates promptly into four almost hemispherical half-carpels. The corolla is unusually large for the genus. Many years ago we had the plant in cultivation, and thought it very ornamental. It is desirable, and it ought not to be very difficult, to obtain it again. The pure white blossoms are open not merely at sunset, but also (according to my memorandum) for nearly the whole day. The name of *H. convolvulaceum* was applied to it in the Mem. Am. Acad. 6, p. 403, 1859. There is an equally slender style in Grisebach's *H. serpylloides* of the West Indies, and the cone surmounting the stigma is occasionally bearded in other species.

H. parciflorum of Griseb. Cat. Pl. Cub., and mentioned in the Flora of British West Indies, cannot be the *Preslæa parciflora* of Martius (*Schleidenia* Fresen.), for it has a strongly beaked fruit. It is perhaps merely a form of *H. humistratum* Cham.

H. fruticosum Linn., described by Grisebach as having "stigma as long as the style," has (even in a specimen named by and received from him) a style several times longer than the stigma and its tip.

Heliophytum molle Torr. Bot. Mex. Bound. p. 138, with globose, not at all didymous, and when fresh probably more or less drupaceous fruit, I refer to *Tournefortia* = *T. mollis.*

LITHOSPERMUM Tourn. Characters from the insertion of the stamens and length of the style should be suspected; for the tendency to

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H. INUNDATUM Swartz. Stigma cono obtuso capitatum.

H. CURASSAVICUM Linn. Stigma umbraculiforme, cono obsoleto.

§ 8. TIARIDIUM (Lehm. *Heliophytum* DC.)

* Fructus didymus, nuculis parallelis.

H. PARVIFLORUM Linn. Keys of Florida and along the southern borders of Texas.

H. GLABRIUSCULUM. *Heliophytum glabriusculum* Torr. l. c. South-western borders of Texas.

* * Fructus mitræformis. — *Tiaridium* Lehm.

H. INDICUM Linn. Naturalized in Southern Atlantic States.

dimorphism, which is obvious in the *Batschia* section (although not demonstrated in all of the species), may pervade the genus.*

MERTENSIA Roth. A new study of this genus enables me to make a few corrections to my paper on the American species, pub-

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* Our North American *Lithosperma* of the *Batschia* section may be characterized thus.

1. Corolla ut videtur pallide flava: folia floralia minora, calyces fructiferos haud superantia.

L. MULTIFLORUM Torr. in herb.; S. Wats. Bot. King (adnot.), p. 238. *L. pilosum* Gray in Sill. Jour. 34, p. 256, & in Proc. Acad. Philad. 1863, non Nutt. — Colorado in the lower mountains to New Mexico and Texas. The throat of the corolla is nearly naked. Nuttall's *L. pilosum* is the same as *L. ruderale* Dougl. & Hooker. I was misled into taking this species for it through Nuttall's reference of his to *Batschia*, and his idea that the corolla was yellow, whereas in that species it is only yellowish in the manner of *L. officinale*.

2. Corolla aurea vel aurantiaca: folia floralia pleraque conformia, calyces superantia,

+- Oblonga vel ovata: corolla nec tubo prælongo, nec plicis faucialibus fornicato-inflexis.

L. CALIFORNICUM. Pube molli hirsutum; foliis lanceolatis; corolla flava, tubo calyce sesquilongiore, fauce ampliata 5-loba, lobis brevibus, plicis faucialibus obsoletis, annulo ad basim tubi nudo. — *L. canescens* var. Torr. Bot. Whipp. p. (68) 124. — Grass Valley, California, Dr. Bigelow. The anthers are high and the style short; but this is probably only one form.

L. CANESCENS Lehm. Pube molli primum canescens: corolla læte aurea, plicis faucialibus pubescentibus prominulis, annulo basilari nudo. — *L. sericeum* Lehm. must belong to this, but the synonym *Anchusa Virginica* Linn. is to be excluded. I do not know what the glabrous plant in the Linnæan herbarium is; but the Gronovian plant is an *Onosmodium*, Morison's is probably *Lithospermum hirtum*, which is the Puccoon of the Southern States, and Plukenet's may be either species.

L. HIRTUM Lehm. Pube hispida demum asperum; floribus majoribus; corolla læte aurantiaca, plicis faucialibus prominulis, annulo basilari dentibus 10 hirsutissimis instructo. — *L. Bejariense* DC. is of this species.

+- +- Folia omnia linearia angusta: corollæ bene evolutæ tubo prælongo, plicis faucialibus fere fornicatis, lobis inciso- vel undulato-crenulatis.

L. ANGUSTIFOLIUM Michx. *L. linearifolium* Goldie? *Pentalophus longiflorus* & *P. Mandanensis* A. DC., cum syn. cit. etc. *L. breviflorum* Engelm. & Gray, Pl. Lindh. 1, p. 44. — It is to Mr. Bebb (see Amer. Naturalist, 7, p. 691) that we owe the demonstration that the long-flowered species (*L. incisum* Lehm. &c.) is the perfect form, as we may say, which, later in the season and especially upon lateral shoots, goes on to produce depauperate flowers, with corolla and style hardly equalling the calyx, and without doubt of cleistogenous fertilization. In this state it is *L. angustifolium* Michx. — the earliest and an appropriate name.

lished in Silliman's Journal in the year 1862. They mainly relate to the various plants which I had referred to *M. alpina*, of which I had formed a heterogeneous assemblage. Mr. Watson discerned this, and, in the Botany of King's Exploration, distinguished *M. brevistyla*, but without noticing that he had under that name the original *M. alpina*, founded on James's plant of Long's Expedition. *M. alpina* differs, I find, from all the rest, in having extremely short and not broad filaments, and also an included style. In James's plant, as in Mr. Watson's, the stamens are inserted on the middle of the tube of the corolla, and the style hardly surpasses the base of the included anthers. There is another form, as I must regard it, differing only in the insertion of the anthers on the throat, and a correspondingly *longer* style, which brings the stigma up to the level of the orifice of the tube, — a dimorphism the reason and operation of which I do not understand; but something similar occurs in other *Borraginaceæ*, such as *Amsinckia*. The specimens with enlarged filaments, as long as the anthers or longer, and with long capillary exserted style, which I had confounded with *M. alpina*, prove to be the *Pulmonaria lanceolata* of Pursh and *P. marginata* Nutt.; and to it I refer *M. Fendleri*, in which all degrees between a deeply 5-parted and a barely 5-cleft calyx occur, varying even in the same individual. As to *M. Drummondii*, which I had referred to *M. alpina*, and Hooker to *M. Virginica*, I now regard it as an arctic form of *M. Sibirica*. The little folds in the throat of the corolla, which I formerly failed to see, are evident in original specimens in Dr. Torrey's herbarium. The species may be rearranged as subjoined.*

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* MERTENSIÆ Boreali-Americanæ.

§ 1. Stenhammaria. (*Steenhammera* Reichenb.) Nuculæ magis carnosæ demum utriculatæ, lævissimæ, acutæ: corolla brevis.

1. M. maritima Don. Amphigæa.

§ 2. Eumertensia. Nuculæ opacæ, plus minus rugosæ vel scabridæ, obtusæ.

* Corolla tubæformis, prælonga, limbo subintegro, plicis faucialibus obsoletis: filamenta gracilia elongata: discus hypogynus in lobos 2 iis ovarii adæquantes productus. — *Mertensia* Roth.

2. M. Virginica DC. *M. pulmonarioides* Roth. America boreali-orientalis.

* * Corolla limbo subcampanulato 5-lobo, plicis faucialibus manifestis.

+ Filamenta anthera æquilata et breviora vel parum longiora, fauci semper inserta: stylus capillaris e fauce nunc ultra limbum exsertus.

ıde them from *Eritrichium*, with which Dr. This small perforation is occupied by a fili-ss, which remains attached to the receptacle ched. The gynobase is flat, merely umbonate t style.

TROPIOIDES A. DC. Prodr. 10, p. 122. In of (but not known within) the United States, 17, 3108. Also Coulter's Mexican collection, l. Xantus, Lower California, referred to this ither flowers nor fruit, and is very uncertain. to this species by Torrey, in Bot. Mex. Bound. xcepted, are very different, namely, *Eritrichium* Alphonse De Candolle's character is a good one, e leaves are alternate. The slender pedicels are rgid nutlets have a very large scar, occupying the e lower half of the length of the inner face, flat, d thin entire margin, the perforation in its upper hat capitate, entire. Crests in throat of corolla

IBUNDUM. Herbaceum e radice "perenni" vel pedale, cinereo-hispidum; foliis fere omnibus alter-is brevibus paniculatis; pedicellis calyce 2–3-plo us bracteatis; corolla rotato-campanulata calycis eari-lanceolata vix superante, fauce prorsus nuda, datis; filamentis anthera longioribus; stigmate rrime verrucoso-scabris ventre carinatis, cicatrice narginata centro perforata. — *Eritrichium flori-* Mex. Bound. p. 140. — Borders of Texas, moun-'aysano and Rock Creek, near the Rio Grande, rds well in structure with the preceding, except f the crests at the throat of the corolla.

rader. The central and western regions of North species of this genus, and a revision of them was e result of a recent study of them is here ap-exception of the Myosotideous *Eueritrichia*, the

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ERITRICHIUM Schrad. et Auct.

botlrys & *Krynitzkia* (Fisch. & Meyer), DC. Prodr. — *Piptocalyx* Torr.

(*Eritrichium* Schrad., Koch.) Nuculæ gynobasi convexæ xa, cicatrice brevi sæpius rotunda vel oblonga: semen

species on the whole, as now characterized, are fairly well marked. The principal difficulties encountered were the inevitable consequence

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amphitropum adscendens: pedicelli haud articulati: calyx 5-partitus, persistens: corollæ tubus brevis: flores nunc bracteati nunc ebracteati.

* *Echinospermoidea*, nuculis ala pectinata cinctis, arctico-alpina, perennia, floribus læte cæruleis.

E. NANUM Schrad., var. ARETIOIDES Herder. *E. aretioides* DC. *E. villosum* var. *aretioides* Gray in Proc. Acad. Philad. 1863, p. 73; Wats. Bot. King, p. 241. *Myosotis nana* Torr. Ann. Lyc. N. Y. Arctic and Alaskan Islands; highest Rocky Mountains from Wyoming to Colorado and Eastern Utah; the latter smaller in all its parts. In both forms, the pectinate lobes of the wing-like border of the nutlets bear a few rigid bristly points, which only need to turn backwards to be glochidiate.

* * *Myosotidea*, annua (pauca in Amer. Austr. perennia); foliis linearibus, inferioribus sæpius oppositis; corolla alba; nuculis haud marginatis pl. m. rugosis. (Species inter se ambiguæ.)

E. PLEBEIUM A. DC. Procumbens, sparsiflorum; calyce pedicello duplo longiore corollæ limbum parvulum æquante; nuculis glabris grosse rugoso-reticulatis lineam longis ovato-trigonis dorso versus apicem angustatum carinatis. — *Lithospermum plebeium* Cham. & Schlecht. Unalaska and other Alaskan Islands, Chamisso, Harrington. Crests in throat of the small corolla inconspicuous and smooth.

E. CHORISIANUM DC. Diffusum, mox procumbens; foliis inferioribus oppositis; floribus laxe racemosis hinc inde folioso-bracteatis; pedicellis saltem inferioribus calyce 2–4-plo longioribus patentibus fulvo-hirsutis; corollæ lobis tubo suo longioribus calycem multum superantibus, cristis faucialibus conspicuis luteis pubescentibus; nuculis minoribus minus rugosis papilloso-scabris dorso a basi ad apicem subcarinatis; cicatrice anguste oblonga. — *Myosotis Chorisiana* Cham. & Schlecht. *Eritrichium connatifolium* Kellogg in Proc. Calif. Acad. 2, p. 103, fig. 51. *Bothriospermi* sp. Benth. Pl. Hartw. no. 1874. — California, along the coast.

E. SCOULERI A. DC. Erectum, gracile, spithamæum ad pedale; spicis nudis sæpe geminatis demum strictis confertifloris; pedicellis brevissimis erectis; calyce fructifero subclauso; corolla præcedentis vel minore; nuculis minoribus (semilineam longis) rugosis glabratis late ovatis, cicatrice rotunda. — *Myosotis Chorisiana* Lehm. in Hook. Fl. Bor.-Am., non Cham. *M. Scouleri* Hook. & Arn. Bot. Beech. p. 370. *Eritrichium plebeium* Torr. Bot. Whipp. p. 68, non DC. *E. Chorisianum* (no. 408), *plebeium* (406) & *Californicum*, pro parte, Gray, Pl. Hall, in Proc. Am. Acad. 8, p. 397. — Oregon and California, along and near the coast.

E. CALIFORNICUM DC. Bimciale ad subpedale, diffusum; floribus subsessilibus demum sparsis plerisque folio subtensis; corolla minima calyce (fructifero subpatulo) vix longiore, cristis faucialibus inconspicuis fere glabris, lobis tubo suo brevioribus; nuculis ovato-oblongis transversim rugosis scabridis;

of their having been described from time to time in a piece-meal way, and by several different hands.

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foliis fere omnibus alternis parvulis. — *Myosotis Californica* Fisch. & Meyer. — California and Oregon to New Mexico and Saskatchawan.

[E. Kingii Watson (vide p. 60) may be found to belong to this section, when mature fruit is known.]

§ 2. Plagiobothrys. (*Plagiobothrys* Fisch. & Meyer, A. DC.) Nuculæ gynobasi hemisphericæ medio affixæ, ovato-trigonæ, subito acutæ, pl. m. incurvæ, transversim rugosæ, ventre medio concavo ad insertionem strophiolato, strophiola persistente: ovulum amphitropum. Herbæ annuæ, parvulæ, villoso-hirsutæ, floribus *Eueritrichii*.

Four North American species can be made out, one of which is also Chilian, and there is a fifth, *E. tinctorium* A. DC., in Chili; the latter with commonly bracteate and scattered flowers, and nutlets only half as large as in *E. fulvum*. The granulation or murication of the surface of the nutlets is too variable and inconstant for specific characters.

* Nuculæ plus minus opacæ, lineis angustis irregularibus elevatis rugosæ.

E. fulvum A. DC. Spithamæum ad pedale; pube fulva in calycibus rufa; spicis demum laxis; nuculis opacis lineis elevatis grosse rugosis, carina dorsali vix conspicua. — *Myosotis fulva* Hook. & Arn. Bot. Beech. p. 38 & 369. *Plagiobothrys rufescens* Fisch. & Meyer, Ind. Sem. Petrop. 1835, p. 46; A. DC. Prodr. 10, p. 134. *Bothriospermi* sp. Benth. Pl. Hartw. no. 1878. — Chili, California and Oregon.

E. canescens. Pube etiam calycis albida; spicis demum elongatis; nuculis subopacis lineis elevatis longioribus dorso transversim rugosis. — *Myosotis cymosa* Nutt., an unpublished name mentioned in Hook. Kew Jour. Bot. 3, p. 294. *Plagiobothrys canescens* Benth. Pl. Hartw. no. 1871, p. 326. — California, Douglas, Coulter, Fremont, Hartweg; Oregon, Tolmie, Nuttall, E. Hall. Apparently found only towards the coast. The nutlets incline to dehisce down the ventral ridge to the insertion. This species is in Coulter's Collection, no. 511. It is also in that of Douglas, a stout and very leafy form. It is therefore likely to be either the plant referred in Bot. Beechey, p. 369, to *Myosotis flaccida*, or else the *M. muricata* Hook. & Arn.

* * Nuculæ (lato-ovatæ) vitreo-nitidæ, lineis angustissimis fere rectis inter rugas transversales applanatas exsculptæ: corollæ parvæ.

E. tenellum. Molliter hirsutum, pube superne præsertim calycis fulva; caulibus e rosula foliorum radicalium erectis sæpius exiguis; foliis lato-linearibus seu oblongo-lanceolatis; spicis brevibus vel interruptis basi tantum foliatis; nuculis maturis nitentibus albis basi et apice subito contractis quasi cruciatis, facie concava, rugis dorsalibus muricatis. —*Myosotis* (*Dasymorpha*) *tenella* Nutt. in Hook. Kew. Jour. Bot. l. c. p. 295. *Eritrichium fulvum* Wats. Bot. King, p. 243, & Gray, Proc. Am. Acad. 8, p. 397, non A. DC. — British Columbia to the northern and eastern parts of California, and through Idaho and Nevada. The mature nutlets have the aspect of vitreous enamel; the close transverse

CYNOGLOSSUM OCCIDENTALE. *C. Virginico* potius quam *C. grandi* affine, scabrido-hirsutum; caule vix ultrapedali ad apicem fere foliato;

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rugæ run nearly unbroken and straight across the broad back from the low dorsal ridge to the margin.

E. TORREYI. Hispido-hirsutum, pube etiam calycis albida; caulibus diffusis, ramis floridis usque ad apicem sæpius foliosis; foliis oblongis, superioribus inter flores; nuculis albidis nitidulis apice tantum contractis, rugis latis lævissimis. — Sierra Nevada, California; in or near the Yosemite Valley, Torrey, a form with rather erect flowering stems and spicate inflorescence, the bracts hardly exceeding the flowers: Sierra Valley, Lemmon (1874), much branched from the root, diffusely spreading, the flowering branches equally leafy to the top, the upper leaves among and beyond the scattered flowers. Nutlets rather larger than in *E. tenellum*, somewhat over a line long, destitute of the cruciform outline (like that of the club of cards), and of the sharp murication, but at the margin sometimes obsoletely tuberculate.

§ 3. PIPTOCALYX. (*Piptocalyx* Torr.) Nuculæ, gynobasis, et cetera *Krynitzkiæ:* calyx 5-fidus circumscissus, basi membranacea quasi 5-crenulata persistente: corolla fauce prorsus nuda: flores folioso-bracteati sessiles.

E. CIRCUMSCISSUM. Annuum, pusillum, diffusum, albido-hispidum; foliis angusto-linearibus, ramealibus floribusque alaribus et subaxillaribus confertis; staminibus medio tubi corollæ albæ insertis; nuculis oblongo-ovatis lævissimis nitidis gynobasi subulato-pyramidatæ angulo ventrali a basi fere ad apicem adnatis; semine amphitropo-pendulo. — *Lithospermum? circumscissum* Hook. & Arn. Bot. Beech. p. 370. *Piptocalyx circumscissus* Torr. Bot. Wilkes, Phan. Pacif. p. 414, t. 12 B; Wats. Bot. King, p. 240. Southeastern California through the interior desert region to Washington and Wyoming Territories.

§ 4. KRYNITZKIA. (*Krynitzkia* Fisch. & Meyer, cum spp. *Eritrichii* DC., etc.) Nuculæ gynobasi elatæ sæpius angustæ ("styli basi" auctorum) angulo ventrali a basi ad medium vel ad apicem usque affixæ, cicatrice aut angustissima aut inferne latiore pl. m. exarata: semen aut amphitropum aut rarius fere anatropum (*E. leucophæo* excepto): corolla alba fere semper parva: calyx 5-partitus persistens, in spp. genuinis cum fructu incluso articulo quandoque secedens.

* *Eukrynitzkia:* annua, calyce hispidissimo, stylo brevi: nuculæ immarginatæ lateribus obtusis vel rotundatis,

+ Angulo ventrali cicatrice vel sulco angustissimo percurso gynobasi fere subulatæ affixæ.

++ Pusillum, hirsuto-canescens; floribus minimis congestis folioso-bracteatis; corollæ fauce nuda; nuculis lævibus; calyce fructifero diu persistente.

E. MICRANTHUM Torr. Mex. Bound. p. 141. Utah to W. Texas.

++ ++ Parvula; floribus in spicis demum elongandis; calyce setoso-hispido sæpius cum fructu secedente.

E. OXYCARYUM. Hirsuto-canescens, gracile, spithamæum ad pedale; foliis angustissime linearibus; spicis demum strictis confertifloris; corollæ parvæ

foliis viridibus oblongis lanceolatisve plerisque obtusis cum apiculo, inferioribus spathulatis inferne sensim in petiolum alatum attenuatis,

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fauce nuda; setis calycis apice subuncinatis; nucula fertili sæpissime unica ovato-lanceolata acuminata lævissima sesquilineam longa gynobasi 2–3-plo longiore, sulco tenui. — Common in Oregon and California; often confounded with or mistaken for the next, as in the collections of Douglas and Hartweg.

E. LEIOCARPUM, Watson, Bot. King, p. 244. Hispidum; corollæ cristis faucialibus manifestis; nuculis 4 ovatis seu oblongo-ovatis acutis lævissimis nitentibus gynobasi subulatæ altius adnatis et paullo longioribus. — *Krynitzkia leiocarpa* Fisch. & Meyer. *Myosotis flaccida* Dougl. in Hook. California to British Columbia and Saskatchawan.

E. MURICULATUM (A. DC.?) Torr. Bot. Wilkes, l. c. p. 416, t. 13 A. *Myosotis muricata* Hook. & Arn.? A præcedente persimili differt nuculis sæpe majoribus latioribus granulato- vel muriculato-scabris, cicatrice parum latiore.— Same range as the last, but not known so far northward or eastward. To this belong many specimens referred by Dr. Torrey to the next species, and also so referred by Watson in Bot. King. Expl. Perhaps the *Myosotis muricata* of Ruiz & Pav., and *Eritrichium alyssoides* DC., of Chili, are the same thing. Very likely this species is not Hooker and Nuttall's *Myosotis muricata*, as I have not seen it in Douglas's Californian collection. The plants which I possess of that collection, upon one or the other of which *M. muricata* would seem likely to have been founded, are, one of them my *E. oxycaryum*, which is more probably what was referred to *M. flaccida*; the other one, *E. canescens* without fruit, which therefore may represent *M. muricata* Hook. & Arn.

E. ANGUSTIFOLIUM Torr. Spithamæum, diffusum, setis rigidis hispidissimum sæpius cum pilis mollioribus; foliis angusto-linearibus; floribus in spicas elongandas etiam fructiferas confertas arcte sessilibus; calycis fructiferi persistentis segmentis lineari-filiformibus erectis; corollæ parvæ cristis faucialibus prominulis; nuculis (haud ultra semilineam longis) oblongo-ovatis crebre minuteque granulatis ventre sulco ab apice ad basim sensim latiore gynobasi conico-subulatæ affixis. — Pacif. R. R. Exped. 5, p. 363, Bot. Mex. Bound. p. 141. W. Arizona and adjacent part of California. It is no. 500 of Coulter's collection; and no. 76 of that of Xantus in Lower California was correctly referred to it. But specimens of other species, notably of the preceding, have been confounded with it.

+ + Nuculæ (*E. Texano* excepto) cicatrice latiore breviore excavata gynobasi angusto-pyramidatæ vel subulato-conicæ affixæ: corolla parva.

++ Calycis segmenta lanceolata haud incrassata: nuculæ 4 consimiles, triangulari-ovatæ, dorso muricato-granulatæ, vix ultra semilineam longæ.

E. PUSILLUM Torr. & Gray in Pac. R. R. Expl. 2, p. (171) 15. Pygmæum; corollæ cristis faucialibus evanidis; nuculis angulis lateralibus acutis, faciebus internis concavis lævibus, angulo ventrali cicatrice lanceolata infra apicem evanida. — New Mexico and borders of Texas.

E. HISPIDUM Buckley in Proc. Acad. Philad. 1861, p. 462. Spithamæum, cinereo-hispidum, ramosissimum; foliis linearibus; spicis paniculatis laxis sæpe

superioribus basi lata sessilibus semi-amplexicaulibus; pedunculo breviusculo; cyma nuda parvula; corollæ tubo (lin. 2–3 longo) calycis lobis

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foliatis; corollæ cristis faucialibus prominulis; nuculis haud angulatis usque ad cicatricem sat magnam deltoideam excavatam muricato-granulatis. — *E. heliotropioides* Torr. Mex. Bound. p. 140, excl. syn. DC. & pl. Berland. *E. griseum* Torr. in herb. *Amsinckiæ* sp.? Benth. Pl. Hartw. no. 157. Southwestern Texas to New Mexico and Mexico. Very different from *Antiphytum heliotropioides* A. DC., with which Dr. Torrey confounded it. (No. 1572 of Wright's collection is cited by mistake or misprint as 1512.) Fruiting calyx densely hispid, little more than a line long, closed, detached by an articulation at full maturity. Scar of the nutlets occupying the lower half of the inner face. Buckley's specimens (the character being of no account) show that this (and not *E. Texanum*) is his *E. hispidum.*

++ ++ Calycis segmenta linearia, obtusa, setis validis hispida, lin. 2–3 longa, fructifera clausa, costa valida incrassata indurata: nuculæ heteromorphæ, majores: folia subspathulata.

E. Texanum A. DC. Subpedale; floribus in spicis laxis fere aphyllis subsessilibus; nuculis 3 abortivis, unica fertili majuscula oblongo-ovata lævi (minutissime crebreque puncticulata) cicatrice angustissima infra medium gynobasi parvulæ conico-columnari affixa. — Texas, near Austin, &c., Drummond, Wright, E. Hall. Fruiting calyx smaller and with midribs less thickened than in the next, readily separating by an articulation.

E. crassisepalum Torr. & Gray, in Pac. R. R. Expl. l. c. Spithamæum; floribus plerisque folioso-bracteatis breviter pedicellatis; calyce fructifero valde incrassato; nuculis 4 fertilibus, 3 muricato-granulatis, quarta majore fere lævi, cicatrice excavata ovato-lanceolata. — W. Texas and New Mexico to Nebraska and Saskatchawan. The thickened pedicel with fruiting calyx persistent, or very tardily separating by an articulation.

+ + + Nuculæ (immaturæ) a basi fere ad medium gynobasi lato-pyramidatæ affixæ; corolla majuscula, limbo lin. 3–4 lato.

E. Kingii Watson, Bot. King. p. 243, t. 23. Eastern side of the Sierra Nevada. Mature fruit appears not to have been collected. It may refer this peculiar species to the first section or to the following subdivision.

* * *Pseudo-Myosotis* A. DC.: perennia vel biennia, floribus pro genere amplis thyrsoideo-congestis, cristis faucialibus corollæ prominentibus fornicatis, stylo sæpius elongato, antheris lineari-oblongis: nuculæ triquetræ, angulis acutis: gynobasis pyramidato-subulata.

+ Syncarpium depresso-globosum, e nuculis lævissimis crassis circumscriptione fere semicirculari: corolla tubo brevi lato intus basim versus annulo 10-squamulato instructo: spicæ paniculatæ demum elongandæ.

E. Jamesii Torr. in Marcy, Rep. p. 294. *E. multicaule* Torr. l. c., forma hispida. *Myosotis suffruticosa* Torr. in Ann. Lyc. N. Y. 2, p. 225. W. Texas and New Mexico to Wyoming.

primum lineari-oblongis longiore lobis suis 2–3-plo longiore; nuculis mox horizontalibus tumido-convexis. — Sierra Nevada, in the north-eastern part of California, Rev. Mr. Burgess, and Sierra County, J. G. Lemmon.

PECTOCARYA DC. The radicle is certainly not centrifugal, as stated by Alph. De Candolle, in Prodr. 10, p. 1 and p. 120, foot-notes, but centripetal, as declared by Torrey, in Pac. R. R. Expl. 4, p. 124. Also *Cynoglossum pilosum?* Nutt. Gen. 1, p. 114, cannot be *Pectocarya penicillata*, which is unknown east of California. It is doubt-

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+ + Syncarpium ovoideo-pyramidatum: corollæ annulus obscurus: thyrsus densior e spicis brevibus.

E. GLOMERATUM DC. Bienne, hispidum, corollæ tubo calycem hispidissimum haud superante lobis parum longiore: nuculis dorso tuberculato-rugosis.— Var. HUMILE; inferne canescens pube molliore. Saskatchawan and along the higher Rocky Mountains and Sierras. Nuttall collected and gave MSS. names to some very dwarf and silky-canescent forms, which appear to belong here. — Var. HISPIDISSIMUM Torr.: subpedale; spicis magis evolutis vel paniculatis; floribus minoribus. Plains of Upper Missouri to New Mexico. A more distinct variety is

Var. VIRGATUM Porter, Syn. Fl. Colorad. p. 102. (*E. virgatum* Porter in Hayd. Report, 1870, p. 479.) Undique hispidum; caule stricto 1–3-pedali; glomerulis sæpius sessilibus brevissimis foliis fulcrantibus angusto-linearibus plerumque multo brevioribus in spicam longissimam virgatam foliosam congestis. — Colorado Territory, along the eastern base of the Rocky Mountains, and up to 8000 feet; Parry, E. Hall, Porter, &c.

E. FULVOCANESCENS. Perenne, humile, cæspitosum, inferne strigoso- vel subtomentoso-sericeum; corollæ tubo calyce aureo- seu fulvo-hirsutissimo longiore lobis suis 2–3-plo longiore; nuculis granulato-scabris. — *E. glomeratum* var.? *fulvocanescens* Watson, Bot. King, p. 243. — Rocky Mountains to the Sierra Nevada, at 5–11,000 feet, and south to New Mexico. Intermediate and ambiguous between the var. *humile* of the preceding and the following.

E. LEUCOPHÆUM A. DC. Perenne e basi ut videtur lignescente, argenteo-sericeum, superne fulvo-hirsutum; corollæ tubo calycem superante lobis 2–3-plo longioribus; antheris infra-faucialibus; stylo longissimo; nuculis (lin. 1½–2 longis) ovato-triquetris lævissimis eburneis. — *Myosotis leucophæa* Dougl.; Hook. l. c. t. 163. Interior dry region, from the borders of British Columbia to Oregon, E. California, and S. Utah. The flowers, said in Hooker's Flora to be white, are certainly sometimes yellow.

* * * *Pterygium.* Fere *Eukrynitzkiæ*, sed nuculis aut tribus aut omnibus ala crenata vel pectinatilobata circumdatis: annua, calyce fructifero modo generis erecto, lobis ovatis.

E. PTEROCARYUM Torr. Bot. Wilkes, p. 415, t. 13 B; Wats. Bot. King, p. 245. — Var. *pectinatum*, forma alis fructus pectinato-multifidis. — Dry interior region, Washington Territory to Arizona and the borders of Texas. The var. S. Utah, Parry.

less *Echinospermum Redowskii*. All the species of *Pectocarya* in the Prodromus appear to be forms of *P. lateriflora*, except *P. penicillata*, and even that may pass into forms of the other species.

III. *Synopsis of North American Species of Physalis.*

The North American flora hardly contains a more difficult genus for its size than *Physalis*. A painstaking study of all the materials at my command leads to the results which are expressed in the following synopsis.

PHYSALIS Linn.

§ 1. CHAMÆPHYSALIS. *Chamæsarachæ** sat similis: folia nonnulla

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* SARACHA Ruiz & Pav. § CHAMÆSARACHA. Calyx fructifer fere herbaceus, vix venosus, baccæ apice tantum nudæ arcte conformis: semina rugoso-favosa vel puncticulata. Herbæ parvulæ humiles e radice perenni; foliis angustioribus basi in petiolum marginatum cuneato-attenuatis aut subintegerrimis aut inciso-pinnatifidis; pedicellis solitariis rarius geminis filiformibus post anthesin refractis.

* A basi ramosæ, diffusæ vel decumbentes: semina favosa.

S. SORDIDA. *Withania? sordida* Dun. in DC. Prodr. 13, p. 456. *Solanum coniodes* Moricand ex Dun. l. c. p. 64. — The two species of the Prodromus are founded upon the same (less villous, but more pubescent) form of a common Texano-Mexican species.

S. CORONOPUS. *Solanum Coronopus* Dun. l. c. p. 64. *Withania? Coronopus* Torr. Mex. Bound. p. 155. A related but more widely diffused species. It extends westward to Arizona (Dr. Palmer, &c.) and Southern Utah, Capt. Bishop.

S. ACUTIFOLIA Miers in Ann. & Mag. Nat. Hist. 1849, & Ill. S. Am. Pl. 2, p. 19, described from a fragment in herb. Hook. of no. 593 of Coulter's Californian collection, I have not seen, nor any Californian plant of the kind. Not improbably it was collected in what is now Arizona, and perhaps it is the *S. Coronopus;* but the description does not well accord; for the leaves are said to be very acuminate, the peduncle somewhat 2-flowered, this and the pedicel together only half an inch long, and anthers as long as the filament.

* Caules brevissimi conferti, subsimplices: semina læviuscula, plana.

S. NANA. Haud viscosa, pube brevi adpressa subcinerea, subcæspitoso-depressa; foliis in caulibus 1–3 uncialibus confertis ovato-lanceolatis seu oblongo-ovatis acutiusculis subintegerrimis basi rotundata vel cuneata in petiolum longum marginatum decurrentibus; pedicellis filiformibus petiolis brevioribus; corolla ut videtur alba cærulescente ultra semipollicem diametro. — California, in the Sierra Nevada, Nevada Co.? Kellogg (distrib. Kellogg and Harford, no. 719), Sierra Co., J. G. Lemmon. The fruit, recently communicated by the latter, is a rather dry globose berry, a quarter of an inch in diameter, girt and almost enclosed by the hemispherical thin calyx. The affinity to *Physalis grandiflora* is not remote.

sinuato-pinnatifida, omnia basi cuneato-attenuata: corolla plano-rotata, violacea: antheræ luteæ ovali-oblongæ: semina parum numerosa majuscula, dorso crassiore subtuberculato-rugosa. Planta juvenilis atomis papillisve albidis quasi furfuraceis conspersa, cæterum glabra.

1. P. LOBATA Torr. in Ann. Lyc. N. Y. 2, p. 226, & Bot. Mex. Bound. p. 152. *Solanum luteiflorum* Dun. in DC. Prodr. 13, p. 64, at least as to var. *subintegrifolium*. I have not the Berlandierian numbers cited under the typical form, but there is no reason to doubt the species. The corolla probably is never yellow in the living plant. The seeds are not very few, as Torrey at first supposed, but are pretty large. The aspect of this small and low species is peculiar and much like that of *Chamæsaracha;* but the fruiting calyx is that of a true *Physalis*. The papillose scurf, in place of pubescence, is peculiar, but very sparse or evanescent.

§ 2. EUPHYSALIS. Semina plano-compressa margine angusto lævi. Nunquam furfuraceo-atomiferæ.

* Corolla læte alba vel cærulescens, concolor, late rotata, fauce tomentosa: antheræ luteæ vel cærulescentes: calyx fructifer bacca repletus, subglobosus: pubes simplex. Annuæ.

2. P. GRANDIFLORA Hook.; Gray, Man. ed. 5, p. 381. — Michigan to Saskatchawan. Corolla an inch to fully an inch and a half in diameter. Pubescence of young parts villous and viscid. Pedicels often in threes. Orifice of fruiting calyx open at maturity.

3. P. WRIGHTII. Humilis, diffuse ramosa, subglabra, pube minima perbrevi parca; foliis oblongis plerumque sinuato-dentatis repandisve basi acutis (pollicaribus); pedicellis filiformibus flore calyceque fructus (semipollicari) longioribus; corolla ut videtur alba diametro ultra-semipollicari; antheris aut cæruleo tinctis aut luteis (in sicco). — Prairies along the San Pedro River, Southwestern Texas, C. Wright, no. 1602. Apparently the same at Fort Yuma on the Rio Colorado, Schott, Thomas, in herb. Torr.; but the specimens are insufficient.

* * Corolla flavida, luridi-ochroleuca, seu viridula, fundo fere semper fusco vel brunneo-purpureo.

+ Annuæ, fere glabræ, nec stellato- nec viscido-pubescentes: antheræ violaceæ.

++ Parvifloræ: calyx fructifer amplus vesicarius, primum carinato-angulatus basi umbilicatus, maturitate subrepletus, dentibus conniventibus clausus: caules ramique insigniter angulati: petioli elongati.

4. P. OBSCURA Michx. (excl. β). Divaricato-ramosissima; foliis late deltoideo-ovatis nunc subcordatis breviter acuminatis inæqualiter dentatis; corolla flavida maculis fusco-purpureis; calyce alte 5-fido, lobis lanceolato-subulatis, fructifero ovato-pyramidato lævigato 5-carinato. — I have this only from Key West, Blodgett, and E. Texas, E. Hall, no. 503; also from Cuba, C. Wright, no. 3635, referred in his "Fl. Cubana" to *P. pubescens*. I suspect it may be *P. Brasiliensis* of Sendtner, Fl. Bras.; if so, his "corolla unciali" has a fraction left out. This in our species is smaller, or at least shorter, than in *P. angulata*.

5. P. ANGULATA Linn. Foliis sæpius ovato-oblongis e basi late cuneata pl. m. laciniato-dentatis; pedicellis filiformibus; corolla viridula immaculata; calyce lobis triangulatis tubo brevioribus, fructifero 10-angulato angulis 5 primariis carinatis ovato-pyramidato demum fructu fere repleto globoso-ovato.

Var. LINKIANA. Foliis dentibus lanceolato-subulatis elongatis magis laciniatis; calycis profundius fissi lobis angustioribus. — *P. Linkiana* Nees in Linnæa, 6, p. 471.

6. P. ÆQUATA Jacq. f. Ecl. 2, t. 137. Ramosissima, erecta, hinc inde pilosula; foliis plerisque parvulis ovatis oblongisve repandis vel sinuato-dentatis; pedicellis calyce etiam florifero brevioribus; corolla lutea fauce maculata; calyce lobis latis brevibus ovato-triangularibus, fructifero demum globoso-ovato 10-nervio pollicari vel minore. — *P. Philadelphica* var. *minor* Dun. in DC. l. c. ex char. & hab. — Along the southern borders of the United States, from Texas to California: also W. Indian.

++ ++ Mediocrifloræ: corolla lin. 7–12 diametro: calyx fructifer ultrapollicaris bacca rubella vel purpurea distentus, ore aperto.

7. P. PHILADELPHICA Lam. *P. chenopodifolia* Willd., non Lam. *P. atriplicifolia* Jacq. Fragm. t. 85, ex Nees.

+ + Annuæ vel perennes, graveolentes, pilis viscidis vel glandulosis omnino simplicibus patentissimis villosæ vel pubescentes: calyx fructus ovato-pyramidatus carinato-angulatus, baccam viridem vel lutescentem laxe vestiens: folia ovata vel cordata.

++ Annuæ: antheræ sæpissime violaceæ: pedicelli plerumque breves.

8. P. PUBESCENS Linn. — *P. pruinosa* Linn.? (Flowering specimen in herb. Linn. with long pedicels, and anthers said to be yellow, but corolla only half an inch in diameter; so probably not no. 10, but same as Dill. Elth. t. 9, referred here in Linn. Syst., and seemingly not from N. America.) *P. Barbadensis* Jacq. Misc. & Ic. Rar. t. 39.

P. obscura var. *viscido-pubescens* Michx. l. c. *P. hirsuta* & *P. pubescens* Dun. l. c. — Corolla small.

P. FŒTENS Poir., or at least of Nees and of Dunal, comes here, and in the size of the corolla, &c., resembles the next; but it is more glandular, has shorter pedicels and blue or bluish anthers, and, it is said, an annual root.

++ Perennes: antheræ sæpissime luteæ.

9. P. VIRGINICA Mill. Graveolens, viscido-villosa, 1–2-pedalis e surculis filiformibus repentibus; foliis ovatis seu ovato-oblongis subcordatisve sæpius acutis; pedicellis sæpe pollicaribus calycem fructus raro æquantibus; corolla expansa fere pollicem diametro. — Mill. Dict. & Fig. t. 206. *P. heterophylla* Nees. *P. heterophylla*, *nyctaginea*, & *viscido-pubescens* (excl. syn.) Dun. in DC. l. c. *P. viscosa* Gray, Man., non Linn. Upper Canada to Florida and Texas.

Var. AMBIGUA: forma major, eximie hirto-villosa; antheris violaceis. — Wisconsin, Lapham, to Upper Missouri River, Suckley, and Lake Winnipeg, Bourgeau (no. 1). Two or three other perennial species have anthers varying to bluish or violet.

10. P. HEDERÆFOLIA. Odore haud ingrato redolens, spithamæa ad pedalem e caudice sæpius crasso, crebre viscido-pubescens, sæpe in novellis villosa; foliis rotundato-cordatis nunc subreniformibus nunc fere ovatis grosse parceque angulato-dentatis (semi- ad sesquipollicem diametro); pedicellis (lin. 2–4 longis) flore fructuque brevioribus; corolla semipollicem diametro. — *P. Alkekengi?* var. *digitalifolia* (vix Dun.) & *P. mollis*, pro parte, Torr. l. c. Rocky hills, &c., New Mexico, S. W. Texas, Arizona, and adjacent parts of Mexico. This is Wright's no. 528 in part, 1597, and 1600, the latter numbers referred by Dr. Torrey to *P. mollis* Nutt., which is a stellate-downy species.

Var. PUBERULA, differt pube brevi densiore subglandulifera vix viscida, caulibus mox decumbentibus. — Western borders of Texas, Wright, no 528, in part.

+ + + Perennes, sæpius humiles, haud viscidæ: antheræ luteæ, in paucis quandoque violaceo suffusæ.

++ Aut glaberrimæ aut cinereo-puberulentæ, pube nunquam stellulata: folia crassiuscula basi lata vel cordata: pedicelli elongati filiformes: corolla luteola concolor.

11. P. GLABRA Benth. Bot. Sulph. p. 39. Known only from Lower California: distinguished by being glabrous even to the calyx, and the leaves inclined to hastate-lanceolate.

12. P. CRASSIFOLIA Benth. l. c. Pube minima simplici quasi pruinosa; foliis (semi–sesquipoll.) ovatis cordatisve; corolla semipollicari.— *P. cardiophylla* Torr. l. c. (forma foliis plerumque majoribus cordatis) & in Ives, Colorad. Exped. Arizona to Lower California.

++ ++ Pube molli stellata vel ramosa cinerascentes vel canescentes: folia pleraque cordata vel ovata basi abrupta: corolla discolor: calyx fructus globoso-ovatus.

13. P. FENDLERI. Pube brevissima partim simplici partim ramosa pruinoso-subcinerea, quandoque subglandulosa; caulibus e caudice crasso ramosis: foliis vix pollicaribus deltoideo-ovatis seu ovato-lanceolatis vix cordatis sæpius acutis margine nunc undulato nunc sinuato-dentato; pedicellis flore brevioribus; corolla semipollicem diametro.— *P. mollis* Torr. l. c. pro parte. Rocks and plains of New Mexico, Fendler (683), Wright (1599), Thurber, Bigelow, and north to Huefano Mountains, Parry.

14. P. MOLLIS Nutt. Pube molli multiramosa vel stellata sæpius implexa cinereo- vel canescenti-tomentosa; foliis (1–2½ pollicaribus) ovatis seu rotundato-cordatis obtusis (imis nunc obovatis) angulato-dentatis repandisve; pedicellis filiformibus sæpius elongatis; calyce fructus plerumque ultrapollicari; corolla lin. 8–10 diametro.—Trans. Amer. Phil. Soc. ser. 2, 5, p. 194; Torr. l. c. pro parte. *P. tomentosa* Dun. l. c.? non Walt. Thickets and along streams, Arkansas River (Nuttall) to Texas and adjacent part of Mexico. This is no. 241 of Drummond's Texan collection, also 205, in a less canescent form, while E. Hall's 500 is a very soft and densely tomentose form.

Var. CINERASCENS. Pube parciori sæpius breviore minus ramosa sordescenti-cinerea; foliis rotundatis vix unquam cordatis; pedicellis nunc filiformibus fructiferis ultrapollicaribus, nunc petiolo brevioribus.—*P. Pennsylvanica*, var. *cinerascens* Dun. in DC. l. c. p. 435. Texas to Mexico. To this belongs Drummond's no. 175, E. Hall's no. 502, &c. Also Coulter's Mexican no. 1222 in part, the other portion representing *P. gracilis* of Miers in Ann. & Mag. Nat. Hist. & Ill. S. Amer. 2, p. 28, t. 39.*

* Two species were received by us under this number, similar in aspect, but abundantly distinct: one, the plant above described; the other, *P. gracilis* Miers (apparently the same as Ervendberg's no. 215), hirsute with simple-jointed hairs, and in other respects also agreeing with the published character and figure. It may be noted, however, that the character "filamentis brevissimis" is contradicted both by the detailed description, "filaments are 3 lines long and the anthers nearly 2 lines long," and by the plate. Neither the one nor the other well accords with the specimen.

++ ++ ++ Pube nunc stellulata, nunc simplici rigidula, nunc vix ulla: folia (rarissime subcordata) sæpissime in petiolum angustata: stylus apice vulgo clavatus: bacca flavida vel rubella.

a. Plantæ ammophilæ plerumque maritimæ, caulibus e surculis filiformibus repentibus: calyce fructus ovato-globosus.

15. P. VISCOSA Linn. Pube brevi stellulata molli undique subcinerea, primum tomentulosa; foliis vulgo ovalibus seu ovatis raro subcordatis subintegerrimis. — Dill. Elth. t. 10; Jacq. Vind. t. 136. *P. Pennsylvanica* Linn. *P. tomentosa* Walt. Car. *P. Jacquini* Link. *P. Walteri* Nutt. in Jour. Acad. Philad. 7, p. 112. *P. maritima* M. A. Curtis in Sill. Jour. ser. 2, 7, p. 407. *P. viscosa, Jacquini, decumbens,* & *fusco-maculata* (Rouville) Dun. in DC. — Shore of Virginia? and N. Carolina to Florida. The species was no doubt founded on the Buenos-Ayrean plant, and it is not clear that Linnæus ever had it from "Virginia." The plant of our coast, if I mistake not, was what Linnæus, in appendix to the second edition of Species Plantarum, named *P. Pennsylvanica,* although he does not pretend to have it from Pennsylvania, and it is not found there. His herb. specimen is "Hort. Ups." I find nothing to distinguish the broader-leaved North American plant from the South American; and the range is not very uncommon for a sub-maritime species. The name alludes to the viscous berry: the herbage is not viscid. In the Manual I inadvertently applied the name of *P. viscosa* to a viscid-leaved species, *P. heterophylla* of Nees.

Var. SPATHULÆFOLIA: forma foliis spathulato- seu oblongo-lanceolatis in petiolum longius attenuatis. — *P. pubescens* Gray & Engelm. Pl. Lindh. 1, p. 19. *P. lanceolata,* var. *spathulata* Torr. Mex. Bound. — Sea-beaches of Florida (Palmer) and Texas, Drummond, Wright, Lindheimer, Schott. Glabrate forms approach and may pass into,

16. P. ANGUSTIFOLIA Nutt. l. c. Viridis, primum tenuiter stellulato-pubescens mox glabrata, vel præter margines calycis loborum glaberrima; foliis oblongo-lanceolatis vel oblanceolatis ad linearia (2–3-pollicaribus) in petiolum brevem attenuatis: corolla calyceque majusculis. — Sandy coast of W. Florida and the Keys.

b. Caules e caudice crassiore duriore erecto orti: pube hirsutula simplici vel pilis paucis nunc 2–3-furcatis, sæpe vix ulla: calyx fructus ovato-pyramidatus basi intrusus, sesquipollicaris: folia ab oblongo-ovatis ad angusto-lanceolata.

17. P. LANCEOLATA Michx. Glabella vel hirsuta; calyce sæpius longius hirsuta. — *P. pumila* Nutt. in Trans. Amer. Phil. Soc. l. c. *P. Pennsylvanica* Gray, Man. ed. 5, p. 382, pro parte, non Linn.?

P. Elliotti Kunze in Linnæa, 20, p. 33. — Lake Winnipeg to Florida, Texas, and Colorado.

Var. LÆVIGATA. Fere glaberrima, lævis præter pilos conicos perbreves ad margines foliorum et calycis; petiolis sat longis; foliis nunc ovatis nunc fere linearibus. — *P. longifolia* Nutt. l. c. *P. pumila?* var. *Sonoræ* Torr. l. c. — Nebraska to Texas and Arizona.

Var. HIRTA. Forma hirsutior, pilis nonnullis 2–3-furcatis; foliis ovatis vel oblongis. — Texas, E. Hall, no. 501, Kansas, J. A. Carruth.

IV. *Characters of various New Species.*

RANUNCULUS OXYNOTUS. Glaber, perennis; rhizomate brevi fibroso multicipiti caules laxos 4–5-pollicares 1–2-foliatos 1–2-floros proferente; foliis radicalibus confertis subreniformibus nunc cuneato-rotundatis, crenato-5–9-lobatis longius petiolatis, caulinis subsessilibus late cuneatis 3–5-fidis, lobis oblongo-lanceolatis; petalis sæpe 6 obovatis basi cuneatis aureis sepalis pilosis multo majoribus; receptaculo primum ovato demum cylindraceo crasso; carpellis perplurimis lævibus semiorbiculatis compressis dorso acutissime carinatis stylo brevi subulato subrecurvo acuminatis. — California, near summit of Castle Peak, Sierra County, at 9,000 feet, J. G. Lemmon. Radical leaves much crowded: petioles about 2 inches in length; the blade less than an inch in diameter. Peduncles 2 or 3 inches long. Sepals and petals deciduous; the latter 3 or 4 lines long, 2 lines broad, deep yellow; scale at base of the claw conspicuous. Head of carpels 3 lines long in flower; in fruit half an inch long, the apparently fleshy cylindraceous receptacle smooth and hardly areolate. Ripe carpels a line long, much compressed, glabrous or occasionally with a very few scattered deciduous hairs, acute-edged both dorsally and ventrally, the dorsal margin conspicuously carinate, twice the length of the subulate flattened style. A strongly marked species, allied to *R. Eschscholtzii* and *R. nivalis.*

RANUNCULUS LEMMONI. *R. alismæfolio* proximus, subacaulis, inferne villoso-pilosus; foliis lanceolatis linearibusve integerrimis; pedunculis scapiformibus prælongis (spithamæis) simplicissimis; petalis spathulato-oblongis parvulis; carpellis pubescentibus turgidis submembranaceis rostro brevissimo subulato inflexo apiculatis in capitulum depresso-globosum digestis. — Sierra Valley, California, alt. 5000 feet, J. G. Lemmon. Petals 3 or 4 lines long, narrow, deep yellow. Sepals tardily deciduous. Mature head of fruit 3 lines high, but 4 lines broad; the turgid and somewhat vesicular carpels $1\frac{1}{2}$ to 2 lines in length.

Corydalis Caseana. Procera (2–3-pedalis) e radice perenni, ramosa; foliis bi-tripinnatis subglaucis; foliolis obovatis oblongisve mucronatis plerisque integerrimis imis subpetiolulatis, ultimis decurrenti-confluentibus; racemis erectis densifloris nunc paniculatis; bracteis plerumque linearibus pedicellum brevem vix superantibus; corolla alba apice cærulescente, calcare crasso recto obtusissimo horizontali vel adscendente; capsula ovali-oblonga turgida lævi stylo gracili subæquilongo superata; seminibus lævibus turgidis. — Sierra Nevada. California, first detected at the "Big Spring" in Big Meadows, Plumas Co., by J. G. Lemmon and Prof. E. L. Case, named in honor of the latter at Mr. Lemmon's suggestion. [It appears that it was several years ago detected by the indefatigable Bolander on Truckee River, near Truckee.] This remarkable species is related to *C. Scouleri* of Oregon. It has a similar capsule, abruptly tipped with a long style and a large stigma. The spur is nearly as long (about half an inch, and double the length of the rest of the flower), but not at all tapering. The corolla is said to be "creamy-white, with pale blue tips." The leaflets are only half an inch in length and are mucronately pointed.

Staphylea Bolanderi. Foliolis 3 late ovalibus vel orbiculatis parum acuminatis; petalis ex ungue latissimo modice spathulato-dilatatis; genitalibus exsertis. — Banks of St. Cloud River, Shasta Co., California, Bolander, April, 1874. Besides the points mentioned in the character, which clearly distinguish this from our *S. trifoliata*, the more filiform filaments are quite glabrous; these and the long styles project conspicuously, being almost twice the length of the petals. Fruit not seen. We have now five species, rather equably dispersed round the world in the northern temperate zone, one eastern and one in Western North America, one in Japan, one in the Himalayas, and one in Europe. Dr. Bolander's name is already associated with many a Californian plant discovered by him. I am glad to have it commemorated by this interesting shrub.

Astragalus Pulsiferi. Phaca, *Inflati:* multicaulis e radice perenni, villosus; caulibus decumbentibus subpedalibus perplurimis; stipulis liberis subulatis: foliis 5–11 obovato-cuneatis sæpius emarginatis subconfertis; pedunculis 3–5-floris folio plerumque brevioribus; pedicellis tenuibus bracteæ subulatæ æquilongis; calycis longe laxe villosi dentibus lineari-filiformibus tubo campanulato duplo longioribus; corolla alba purpureo tincta, vexillo apice bilobo; legumine haud stipitato ovato acuto pubescente membranaceo vesicario 5–8-ovulato 3–5-spermo suturis haud introflexis prorsus uniloculari. — Sierra and Plumas Counties, California, Mrs. Pulsifer-Ames and Mr. J. G. Lem-

mon. Leaflets about 3 lines, flowers 3 or 4 lines, and legume about half an inch in length. The legume refers this well-marked species to the *Inflati* section, but it has no particular resemblance to any other species. I wish it to bear the name of one of the two valued correspondents who discovered and communicated it, namely, Mrs. Pulsifer-Ames, to whom and to Mr. Lemmon we are mainly indebted for our knowledge of the botany of Sierra and Plumas Counties in the northern part of the Sierra Nevada.

PRUNUS (EMPLECTOCLADUS) FASCICULATA. *Emplectocladus fasciculatus* Torr. Pl. Frem. in Smiths. Contr. p. 10, t. 5. To this (notwithstanding the more marked presence of a style and the ovules not really suspended from the summit of the cell) I venture to refer a flowering specimen collected in the northern part of Arizona by Dr. Newberry, fruiting ones collected in the southern part of Utah (at St. George) by Dr. Palmer, in 1871, and both flowering and fruiting ones from the latter district, no. 56 of Dr. Parry's collection in 1874. A thin disk lines the tube of the short-campanulate calyx up to the origin of the calyx teeth, the edge of which is slightly free or salient. The flowers in the specimens at hand appear to have a sterile ovary, but in most cases surmounted by a rather slender style longer than it. Dr. Torrey's figure appears to represent a fertile ovary; but our fruit shows a style a line and a half in length. Otherwise Dr. Torrey's *Emplectocladus* seems to be identical with the plant before us, and it came from the same district. The fruit is globular, 5 or 6 lines long, hirsute-tomentose; sarcocarp very thin, in the dry state coriaceous: putamen globular, smooth, and even, neither suture prominent. Leaves involute-conduplicate in vernation. — Having recently been favored with a fragment and flower from Dr. Torrey's original specimen of *Emplectocladus*, the suspected identity is verified. This name may now be appropriated to the group of American species of which I had referred, one to *Amygdalus*, and others to *Microcerasus* of Webb, but which form a well-marked section by themselves.*

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* PRUNUS § EMPLECTOCLADUS. Flores foliis coætanei, e gemmis monanthis nunc dianthis squamosis. Calyx brevi-campanulatus. Drupa velutina carne tenui, putamine sæpius lævi haud foraminuloso. Folia parva, plerumque fasciculata, vernatione conduplicata.

§ 1. Flores sat majores: petala rubentia et putamen sub-rugulosum hinc acute carinatum *Persicæ*.

P. ANDERSONII Gray Proc. Am. Acad. 7, p. 357; Watson, Bot. King, p. 79.

§ 2. Flores parvi, petalis parvulis albis, staminibus 10–15, stylo sat brevi: putamen subglobosum, læve, immarginatum.

IVESIA WEBBERI. Humilis, laxe villosa; foliis plerisque radicalibus, lamina circumscriptione oblonga petiolo filiformi breviore, foliolis approximatis quasi-verticillatis nempe sessilibus 2–5-partitis, segmentis linearibus integerrimis rarove bifidis; scapo decumbente spithamæo versus medium foliis 2 oppositis paucifoliolatis instructo; cyma confertiflora folioso-bracteata; pedicellis demum calyce longioribus; calycis segmentis accessoriis linearibus (raro bipartitis) vera haud æquantibus; petalis flavis oblongis demum lanceolatis basi attenuatis vix unguiculatis calycem adæquantibus; staminibus 5 oppositisepalis (nunc 2–3 oppositipetalis additis); filamentis demum petala subæquantibus subulato-filiformibus; carpellis 3–4; stylis parum lateralibus. — In ravines, &c., Sierra and Indian Valleys, California, at elevation of about 5,000 feet, Dr. Webber, J. G. Lemmon. A neat and very distinct little species, most resembling *I. unguiculata* in the leaflets; but these are crowded on an inch or less of the rachis, and the villosity is less dense and silky; also the petals smaller and bright yellow. It was first found near the residence of Dr. Webber, the owner of Webber Lake, a gentleman much interested in natural history, and who has efficiently furthered botanical research in the very interesting district in which he is almost the oldest settler. Wherefore this new species may most appropriately bear his name.

MENTZELIA (EUCNIDE) URENS Parry in herb. Suberecta, ramosa, setis urentibus simplicibus e basi papilliformi cum glochidiatis multibarbellatis hispidissima; foliis rotundatis inæqualiter subdentatis penninerviis, inferioribus petiolatis, summis basi semiamplexicauli sessilibus; pedunculis pedicellisque brevibus subcorymbosis; floribus amplis; petalis albis obovatis mucrone sæpius hispido-penicillato apiculatis calycis lobos lanceolatos subduplo (stamina innumera longe) superantibus; filamentis basi coalitis. — *Eucnide lobata* Torr. Bot. Whipp. p. 33, non Gray, Pl. Lindh. Arizona and Utah: rocky ravines of

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* Folia integerrima, obtusa vel retusa, eglandulosa.

P. FASCICULATA. (*Emplectocladus fasciculatus* Torr. Fl. Frem. p. 10, t. 5.) Folia lineari-spathulata, fere sessilia, obsolete triplinervia.

P. MINUTIFLORA Engelm. in Pl. Lindh. Folia oblonga seu elliptica, petiolata, penninervia, venulosa: flores minimi.

* * Folia glanduloso-denticulata, petiolata: flores minimi.

P. MICROPHYLLA. (*Amygdalus microphylla* HBK. Nov. Gen. & Sp. 6, p. 245, t. 564.) Mexico.

§ 3. ? Flores majusculi, petalis sat amplis albis, stylo longo: folia cum calycis lobis creberrime glanduloso-denticulata, vernatione convolutiva ?

P. GLANDULOSA Hook. Ic. Pl. t. 288.

the Colorado near the confluence of Williams River, Dr. J. M. Bigelow, 1854, and in the same district by Dr. Parry in 1867, winter vestiges only; near St. George, Southern Utah, Dr. Parry, in blossom. A showy species, well worth cultivating; the *white* petals an inch and a half in length. Peduncles rather short, mostly 3-flowered and with pedicels not longer than the turbinate calyx-tube. Capsule half an inch long, broad and short, somewhat turbinate. Seeds very numerous and minute, narrow-oblong, ribbed.

MENTZELIA (TRACHYPHYTUM) TORREYI. Hispidulo-scaberrima, humilis, confertim ramosissima; ramis demum candidis; foliis angustis marginibus revolutis, caulinis tri- (–5-?) fidis, lobis lanceolatis, ramealibus integerrimis linearibus sursum sensim subulato-attenuatis; floribus subsessilibus; calycis tubo cum capsula brevissime oblongo utrinque truncato, limbo 5-partito, lobis lineari-subulatis petalis totidem conformibus (albis?) spathulato-lanceolatis staminibusque circ. 25 subdimidio brevioribus; filamentis omnibus filiformibus; stylo 3-partito; ovulis 7; seminibus (lineam longis) turgidis pyriformi-oblongis parum tetragonis subrugosis nigris. — Sterile saline plains of Humboldt County, Nevada, collected only by the late Dr. Torrey in 1865.

PETALONYX PARRYI. Frutescens; ramis usque ad flores capitato-spicatos foliosis; foliis inferioribus oblongis spathulatisve integerrimis subsessilibus, superioribus majoribus rhombeo-obovatis ovatisve crenatis basi acutis brevi-petiolatis; calycis lobis linearibus ovario bis longioribus unguibus petalorum flavescentium paullo brevioribus. — St. George, Southern Utah, Parry. Much resembles *P. nitidus* of Watson, of Southern Nevada; but the leaves of that are very obtuse or rounded at base, the flowers smaller (in ours the petals are fully 5 lines long and decidedly yellowish), and the calyx-lobes shorter than the ovary, and only one-third the length of the claws of the petals. In all three species, instead of "didymous," the anthers should rather be described as four-celled, their two short cells deeply divided or didymous. *P. Parryi* has a woody base; and a specimen of *P. Thurberi*, collected by Dr. Cooper on the eastern borders of California, is said to be "a shrub two feet high."

THELESPERMA SUBNUDUM. Nanum; caulibus e caudice multicipiti perenni brevissimis foliosis; foliis crassiusculis rigidulis 1–2-ternatipartitis, segmentis brevibus lineari-lanceolatis vel oblanceolatis; pedunculis simplicissimis scapiformibus spithamæis; ligulis nullis; acheniis lævibus coronula obtuse 4–5-dentata nuda superatis. — St. George, Southern Utah, Dr. Parry. Resembles *T. subsimplicifolium* var. *scaposum*, which was also collected by Dr. Parry.

GAILLARDIA ACAULIS. Nana, perennis, puberula; foliis in caudice subcrasso multicipiti confertis crassiusculis obovatis petiolatis margine undulatis vel subdentatis; scapo prorsus nudo subspithamæo monocephalo; involucro disco breviore, squamis extimis ovato-oblongis, intimis lanceolatis tenuiter acuminatis; floribus radii discique flavis; fimbrillis receptaculi ovato-subulatis brevibus; corollarum disci lobis triangulari-ovatis obtusiusculis; pappi paleis 9 ovali-oblongis omnibus aristatis. — Southern Utah, Dr. Parry. A very remarkable dwarf perennial species. Disk half an inch in diameter: ligules rather numerous, hardly half an inch long.

CHÆNACTIS ATTENUATA. Annua, glanduloso-subpuberula; caule spithamæo corymboso-ramoso; ramulis pedunculisve filiformibus; foliis paucipartitis filiformibus; involucro oblongo-cylindraceo 12–18-floro, squamis angusto-linearibus apice filiformi-attenuatis; receptaculo epaleato; corollis albis, marginalibus vix ampliatis; pappo conformi e paleis 4 late obovato-cuneatis truncatis achenio corollaque quadruplo brevioribus. — Ehrenberg, Arizona, collected by A. E. Janvier, communicated by William M. Canby. Heads narrow, only 5 lines long. This neat little species is closely related to *C. carphoclinia* Gray, with which it agrees in having attenuated tips to the involucral scales, in this more prolonged; but the receptacle is naked, the heads narrow and fewer-flowered, and the pappus throughout of very short and broad paleæ. The now numerous species of *Chænactis* may be discriminated as follows: * —

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* CHÆNACTIS DC.

§ 1. EUCHÆNACTIS. Pappus paleaceus.

* Corollæ flavæ, extimæ superne ampliatæ limbo pl. m. irregulari; involucri squamæ obtusæ vel obtusiusculæ.

+- Pappus simplex, e paleis 4 raro 5.

1. C. LANOSA DC. Floccoso-lanata, nunc denudata; capitulo vix semipollicari in pedunculo scapiformi 3–6-pollicari.

2. C. GLABRIUSCULA DC. Minus lanata, ramosa, magis foliosa; capitulis nunc subcorymbosis ¼–⅓-pollicaribus; pedunculis validioribus 2–7-pollicaribus. — Var. *macrocephala* Gray, in Bot. Whipp., forma mera validiori, = *C. denudata* Nutt. Pl. Gamb.

3. C. TENUIFOLIA Nutt. Parum lanulosa, mox glabrata; caule ramoso folioso; capitulis circiter ¼-pollicaribus subcorymbosis brevi-pedunculatis; involucri hemisphærici squamis numerosis angustis; acheniis breviusculis. — *C. filifolia* Gray, Pl. Fendl. p. 98?

+- +- Pappus duplex (saltem fl. disci), e paleis 1–4 exterioribus cum 4 majoribus alternantibus.

4. C. HETEROCARPHA Gray, Pl. Fendl. p. 98. — Var. TANACETIFOLIA. Nana;

ANTENNARIA MICROCEPHALA. Argenteo-sericea, haud stolonifera; caulibus e caudice cæspitoso spithamæis gracilibus strictis foliosis;

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foliis bipinnatipartitis plerisque rosulatis, lobis brevibus crebris; radice bienni. — *C. tanacetifolia* Gray, Proc. Am. Acad. 6, p. 545.

* * Corollæ albæ vel carneæ,

+ Extimæ limbo pl. m. ampliato obliquo, discum haud superantes: involucri squamæ numerosæ angusto-lineares, obtusæ: pappus simplex, e paleis 4–5 æqualibus. Herbæ lana tenui mox evanida.

5. C. BRACHYPAPPA Gray, Proc. Am. Acad. 8, p. 390. Pedalis; foliis bipinnatipartitis, lobis brevibus rigidulis divaricatis; pappi paleis quadratis achenio quadruplo brevioribus.

6. C. STEVIOIDES Hook. & Arn. Spithamæa; foliis 1–2-pinnatipartitis, lobis parcioribus angusto-linearibus summisve integris: pappi paleis lanceolatis oblongisve acutis achenio vix brevioribus.

+ + Corollæ exteriores vix vel parum ampliatæ, limbo fere regulari.

++ Involucri squamæ in acumen filiforme vel subulatum productæ: pappus simplex e paleis 4 raro 5: capitula parva. Pubes minuta subglandulosa, nec lanulosa.

7. C. CARPHOCLINIA Gray in Bot. Mex. Bound. p. 94. Spithamæa, rigidula; involucro campanulato multifloro, squamis subulato-acuminatis; receptaculo paleis 5–10 aristiformibus persistentibus instructo; pappi paleis ovato-lanceolatis acuminatis achenio subæquilongis, in fl. extimis nunc abbreviatis truncatis.

8. C. ATTENUATA Gray, supra.

++ ++ Involucri squamæ obtusæ vel obtusiusculæ muticæ.

a. Pappus duplex biformis, e squamis 4 exterioribus brevissimis et 4 interioribus majoribus: folia raro 2-pinnatifida, lana tenui mox decidua; capitula majuscula.

9. C. XANTIANA Gray, Proc. Am. Acad. 5, p. 545. Subpedalis, valida; capitulo fere pollicari in pedunculo fistuloso; foliis in segmenta 3–7 angusto-linearia partitis; antheris demum exsertis (modo præcedentium); pappi paleis interioribus lanceolatis corollam subæquantibus, exterioribus obovatis vel obcordatis multo brevioribus. — Var. INTEGRIFOLIA Gray, l. c., forma mera graciliori stenocephala, foliis sæpe integris.

10. C. MACRANTHA D. C. Eaton in Bot. King, p. 171, t. 18. Spithamæa; capitulo $\frac{1}{2}$–$\frac{3}{4}$-pollicari in pedunculo gracili; foliis 1–2-pinnatipartitis, segmentis oblongis vel lato-linearibus; *antheris inclusis;* pappi paleis interioribus lineari-oblongis corolla carnea dimidio brevioribus, exterioribus cuneato-oblongis multo minoribus.

b. Pappus e paleis 8–12 consimilibus: folia sæpissime bipinnatifida, lobis brevibus crebris: herba albo-tomentosa, rarius denudata.

11. C. DOUGLASII Hook. & Arn. *C. achilleæfolia* Hook. & Arn. *Hymenopappus Nevadensis* Kellogg.

§ 2. ACARPHÆA Gray. Pappus nullus: folia 1–3-pinnatisecta.

12. C. ARTEMISIÆFOLIA. *Acarphæa artemisiæfolia* Gray, Pl. Fendl. p. 98, & Bot. Mex. Bound. p. 95, t. 32.

foliis oblanceolatis imisve spathulatis, superioribus in bracteas subulatas paniculæ laxæ nudæ decrescentibus; capitulis parvis numerosis (lin. 1½–2 longis); involucro mox glabro pallide fusco nunc roseo tincto, masculo obovato, fœmineo cylindraceo, squamis oblongis omnibus tenuibus obtusis; acheniis crebre glandulosis; pappo fl. fœm. corollam haud superante, fl. masc. e setis maxime clavellato-dilatatis. — Washoe Valley, Nevada, Mr. Stretch, the male plant; Sierra County, California, J. G. Lemmon, male and female. Remarkable for its small, narrow, and loosely paniculate heads: the silvery pubescence finer and closer even than in *A. luzuloides.*

SENECIO GREENEI. Primum araneoso-subtomentosa, mox glabrata; caule simplici e radice perenni subpedali 1–3-cephalo; foliis plerisque radicalibus ovali-subrotundis crenato-dentatis basi subcuneatis longius petiolatis, caulinis parvis subspathulatis superioribus in bracteas subulatas decrescentibus; involucro campanulato 20-phyllo ecalyculato; ligulis 9–14 lato-linearibus flammeis vel croceis: styli ramis cono obtusissimo annulo setularum cincto centro cuspidato superatis! — California, in woods near the Geysers, E. L. Greene, who, although new to California, has found this distinct species in a district often visited by botanists and amateurs. Blade of the radical leaves barely an inch or two long. Involucre fully half an inch high, and the flame-colored rays half an inch long: tips of the disk-corollas also orange. The fringe around the style-tips and the setulose cusp are found in no other genuine North American species. Akenes glabrous.

COLLINSIA GREENEI. Tenuis, glanduloso-puberula; foliis sublinearibus, mediis inciso-dentatis; pedicellis solitariis ternisve calyce vix longioribus; calycis 5-partiti lobis lanceolatis obtusiusculis glandulosis; corolla violacea, fauce oblonga, limbo brevi, labio superiore sub lobis fornicato-cristatis, inferiore subduplo longiore lobis lateralibus angustis. — California, in crevices of rocks in the mountains of Lake County, E. L. Greene, June 19. — Leaves about an inch long. Corolla about 5 lines long; the short upper lip above the gorge furnished with a peculiar palatine crest of two conspicuous obtuse callous teeth on each side, connected by a less elevated ridge; lateral lobes of the lower lip unusually small. Filaments and the inside of the oblong saccate throat (which is longer than the limb) beardless. A peculiar species, one of the early fruits of Mr. Greene's close observation in the region in which he has recently taken up his residence.

GILIA FILIFORMIS Parry. Inter *G. micromeriam* et *G. campanulatam* collocanda, spithamæa e radice annua exili, effuso-ramosissima; ramis et pedicellis cum foliis integerrimis (imis solum oppositis) filifor-

mibus; corolla luteola campanulata calycis lobis lanceolato-subulatis staminibusque paullo longiore, lobis truncatis obsolete eroso-denticulatis; stylo capsula vix breviore; seminibus in loculis circa 6–8. — Southern Utah, on the detritus of volcanic rocks, Dr. Parry. Leaves an inch or less in length, all perfectly simple, only the small early ones opposite, all the upper ones shorter than the slender internodes. Earlier pedicels half an inch long, seldom deflexed, the latest only a line long. Calyx-lobes a line long, very acute or cuspidate, the margins slightly scarious-margined. Corolla barely 2 lines long, deeply 5-cleft, "cream-color." Anthers globular. Seeds mucilaginous, but not spirilliferous.

Gomphocarpus purpurascens. *G. cordifolio* Benth. (*Acerat. cordifoliæ* Benth. Pl. Hartw. & *A. atropurpureæ* Kellogg) affinis, multo minor, cinereo-puberula; foliis crassis subcordatis obtusis sesquipollicaribus brevi-petiolatis; pedunculis umbella densa parum longioribus; pedicellis albo-pubescentibus flore duplo longioribus; corollæ rubro-purpureæ lobis oblongis; cucullis albidis saccatis toto gynostegio adnatis dependentibus subclausis, lobulis alternantibus coronæ manifestis; antheris viridescentibus. — California, on the bare summit of a mountain in Lake County, not far from the Geysers, Mr. Towle, communicated by E. L. Greene.

Audibertia Clevelandii. Fruticosa, orgyalis, cinereo-tomentulosa; foliis oblongo-oblanceolatis obtusis crenulatis rugulosis basi attenuatis subpetiolatis, floralibus parvulis ovatis; verticillastris laxiuscule capitatis in axillis breviter vel longius pedunculatis raro proliferis; bracteis ovalibus calyce sæpius dimidio brevioribus subglanduloso-pubescentibus; calyce spathaceo, labio superiore amplo apice cuspidato, denticulis lateralibus nunc manifestis: corollæ cæruleo tinctæ (lin. 7–8 longæ) tubo gracili exserto, labiis angustis; genitalibus modice exsertis; filamento ad articulationem breviter dentato. — Mountains behind San Diego, California, at the elevation of about 2,200 feet, D. Cleveland, — to whom, as the discoverer, this distinct new species of an interesting genus is dedicated. The *Audibertiæ* are said to be invaluable bee-plants.

Eriogonum spathulatum. *Capitata:* lana adpressa subfloccosa incanum, multicipiti-cæspitosum; caulibus floridis ima basi tantum foliaceis cæterum nudis scapiformibus ultraspithamæis simplicibus monocephalis vel sæpius umbellato-tricephalis; foliis anguste spathulatis (1–2-pollicaribus lin. 3–4 latis) in petiolum sensim attenuatis; capitulo et umbella longe subæqualiter triradiata breviter subulato-bracteatis; involucris 7–12 oblongo-turbinatis 6-dentalis lanulosis plurifloris;

perigonio albo glaberrimo basi subcrassa 6-angulata; segmentis spathulato-oblongis retusis, interioribus parum angustioribus; filamentis basi hirsutulis; achenio elongato, angulis scabris. — Southern Utah, Dr, Parry, no. 245. Plant with much the aspect of *E. multiceps*, on a larger scale, with mostly triradiate scapes.

ERIOGONUM PARRYI. (*Pedunculata*, inter subdiv. * et * * inserendum.) Annuum; foliis omnibus radicalibus reniformi-rotundatis firmis (subpollicaribus) undique cum petiolo elongato albo-lanatis; scapo paniculaque effuso-ramosissima ultraspithamæa glandulis viscosis parvulis crebris obsitis; pedicellis involucro angusto-turbinato (lineam longo) 4–5-lobato 7–9-floro aut paullo aut inferioribus 2–4-plo longioribus, fructiferis sæpius deflexis; bracteolis filiformibus subglanduloso-ciliatis; perigonii basi brevi obtusissimo, segmentis albis linea media viridula, exterioribus subcordato-ovatis obtusissimis, interioribus multo minoribus oblongo-ovatis acuminatis. — Southern Utah, Dr. Parry, no. 239 (1874). A well-marked species of this group, with the foliage of *E. deflexum*, the involucres rather of *E. Watsoni*, but the stems from the base of the scape up to the involucres beset with small stipitate glands, of a character between those on the pedicels of *E. nutans* and those on the whole panicle of *E. glandulosum;* and in the structure of the perigonium different from all of them. To be reached by the key in the Rev. Eriog., a line should be inserted on p. 151, before line 20, thus: Herbæ annuæ, præter folia tenuiter viscoso-glandulosæ.

SCIRPUS (ELEOCHARIS) WOLFII. Rhizomatibus tenerrimis repentibus perennans, cæspitibus parvis sparsis; culmo pedali gracili glaucescenti-pallido ancipiti hinc plano illinc convexo undique tenuiter striato, vagina ore oblique truncato hyalino; spica ovato-oblonga acuta; squamis oblongo-ovatis obtusis scariosis pallidis purpureo tinctis; stylo tripartito; achenio pyriformi nitidulo subæqualiter obtuse circiter 9–costato inter costas transverse lineato-ruguloso, tuberculo parvo depresso truncato centro pl. m. apiculato; setis perigynii (an semper?) nullis. — Margin of ponds, in very wet soil, Fulton County, Illinois, John Wolf. Probably it will prove to be not uncommon. I have specimens collected in the same region, doubtless at Athens, Illinois, in the year 1861, by Elihu Hall. Professor Wolf in a letter alludes to six setæ of the perigynium; but I detect none whatever in the specimens. The spike as to form and imbrication of the scales is much as in *S. tenuis* and *S. compressus*, &c.; but the achenium, with its several longitudinal ribs and delicate transverse lineation, is upon the plan of that of *S. acicularis*. This renders the species a very peculiar and distinct one.

SCIRPUS (FIMBRISTYLIS) APUS. Annuus, cæspitans, pygmæus; spicis numerosis in caulibus brevissimis inter folia radicalia et subradicalia longe superantia capitato-congestis, singulis oblongo-cylindraceis; squamis lanceolato-ovatis acutis scariosis costa valida fusca percursis; floribus monandris; achenio stipitulato obovato-lenticulari marginato fere lævi apice nudo; stylo glabro apice bifido basi breviter bulboso secedente. — Wet shores of Clear Lake, Lake County, California, Bolander. This little plant was discovered many years ago by Dr. Bolander, but has been left undescribed. It forms depressed tufts on the ground; the leaves an inch or two long, pale green, filiform-subulate, flat, roughish; their sheathing bases dilated, whitish, striate, involucrate around the clusters of spikes. The spikes themselves are two or three lines long.

III.

GRAPHICAL INTEGRATION.

By Edward C. Pickering.

Presented, Oct. 13, 1874.

When determining the relation between two physical quantities, we sometimes are able to measure only the relative rates at which they alter, instead of the alterations themselves. Or, to speak mathematically, if $y=f(x)$, instead of measuring various corresponding values of x and y, we can obtain only the values of x and $\frac{dy}{dx}=f'(x)$. Of course, if the form of $f'(x)$ is known, the ordinary methods of integration give $f(x)$ and y. But in general this is not given, and the usual methods of approximation are liable to introduce large errors, since by the summation the error adds, and the deviation continually becomes greater and greater. The problem is perhaps better understood by some familiar examples. Thus, given the velocity of the wind at certain times, to determine its total distance travelled per hour; given the velocity of a river, at various points of its cross-section, to find its total discharge; given the strength of an electric current, to find the total quantity transmitted. The case which actually suggested this problem was in calibrating a thermometer tube, having given the length of a mercury column at various points in the tube, to determine the correction to be applied for unequal diameters of the tube at various points. Here the various lengths of the column give the values of $\frac{dy}{dx}$, and the distance of its centre from one end gives the corresponding values of x. Construct a curve with these two quantities as coordinates, and the area included between this curve and the axis of X serves to measure the true values of y. To determine this area, draw a number of equidistant ordinates, and read from the curve the length of each. Then compute by Simpson's formula, $A=\frac{1}{3}a$ $[(y_0+4y_1+y_2)+(y_2+4y_3+y_4)+\&c.]$, the area included between

each second ordinate, the curve, and the axes. It gives the ordinate of points of the required curve, $y = f(x)$, the abscissa being of course that of the limiting ordinate.

To test these principles by an actual example, the following method was employed. A smooth curve was drawn by a pencil on a sheet of paper divided into squares, and the co-ordinates of six points on it noted as follows: $x = 0.7$, $z = .84$; $x = 2.3$, $z = 1.14$; $x = 4.4$, $z = 1.65$; $x = 5.8$, $z = 2.05$; $x = 7.6$, $z = 2.69$; $x = 9.6$, $z = 3.54$. It was then assumed that by some measurement these observations had been obtained, and that while x represented one of the variables z gave the relative rate of change, or $\frac{dy}{dx}$. These points were then laid off on a fresh piece of paper, and a smooth curve drawn through them. Of course this should agree with the original curve, were there no errors; and the deviation serves to show the amount of error to be expected. To obtain two independent results, a third curve was constructed, like the second, on another piece of paper. The values of z for $x = 1, 2, 3$, &c., were then determined on curves two and three, with results given in Table I., columns two and three. Applying Simpson's formula gives the numbers in columns four and five, which it will be seen agree very nearly, the difference being but little more than the errors of observation. Of course, if necessary, still closer results could be obtained, by residual curves and other methods; but in general the accidental errors present in the original observations render this refinement unnecessary.

TABLE I.

x	z'	z''	y'	y''	Δ
0	.73	.72	0.000	0.000	.000
1	.87	.87			
2	1.08	1.06	.882	.877	—.005
3	1.30	1.30			
4	1.54	1.54	2.185	2.177	—.008
5	1.82	1.82			
6	2.12	2 11	4.075	4.065	—.010
7	2.46	2.47			
8	2.84	2.82	6.542	6.533	—.009
9	3.26	3.26			
10	3.77	3.77	9.816	9.805	—.009

As another example, suppose the following measurements made in calibrating a thermometer tube: $x = 5°$, $z = 10°.0$; $x = 28°$, $z = 10°.4$; $x = 54°$, $z = 10° 7$; $x = 83°$, $z = 10°.9$, in which z gives the length of the mercury column, and x the position of its middle point.

The problem is to determine the correction to be applied to the observed temperatures, assuming the 0° and 100° points to be correct. Constructing a curve with the co-ordinates given above, we deduce the points given in columns one or two of Table II. Now, calling m the volume of the mercury drop, we have $z : m = dx : dv$, or $\frac{dv}{dx} = \frac{m}{z}$. Hence, we must use for ordinates in our summation the reciprocal of z as given in column three. Treating these as before, we obtain by the formula column four, and dividing by the total sum 283.8 gives in column five the true temperature, and subtracting the observed readings from these gives the correction in column six.

TABLE II.

t°	L	$\frac{dv}{dx}$	v	t'°	Δ
0	9.9	10.10	0.0	0°.00	0°.00
10	10.1	9.90			
20	10.3	9.71	59.4	20°.93	0°.93
30	10.4	9.62			
40	10.5	9.52	117.1	41°.26	1°.26
50	10.6	9.43			
60	10.7	9.35	173.3	61°.06	1°.06
70	10.8	9.26			
80	10.9	9.17	228.9	80°.65	0°.65
90	10.9	9.17			
100	11.0	9.09	283.8	100°.00	0°.00

To determine how rapidly the errors diminish, increasing the number of ordinates, the area included between the axis and the curve $y = \frac{1}{\pi} \sin x$ was computed for 2, 4, 6, 12, and 18 divisions; the errors in these cases were .030047, .001454, .000276, .000019, .000003, so that a high degree of accuracy is readily obtained. M. Chevilliet has recently shown (*Comptes Rendus*, lxxviii. p. 1841) that the error in Simpson's formula depends on $\frac{h^4}{180} \frac{d^3 y}{d x^3}$, while the method of summing by trapeziums gave $\frac{h^2}{12} \frac{dy}{dx}$. In an example he finds that the area of the curve $x \log x$, between $x = 10$ and $x = 20$, is given correctly by Simpson's formula, taking ten intervals, within .000005, while by the method of trapezoids the error is .001809. Evidently, then, it is easy to obtain by the first of these formulas as great an accuracy in the result as is needed in almost any physical research.

IV.

ON THE SOLAR MOTION IN SPACE.

By Truman Henry Safford.

Presented, Nov. 11, 1874.

I. It was first suggested by Sir W. Herschel that the sun with its planets is moving towards the constellation Hercules. That the sun moves seems to be a necessary consequence of the law of universal gravitation; but in what direction was not noticed until Herschel pointed it out, upon rather imperfect evidence.

Bessel doubted that the evidence proved any thing certain with reference to this motion of the sun, but began the collection of more facts. This was continued by Argelander, who first fairly solved the problem, by Pond, the Struves, and others; and discussions by Lundahl, O. Struve, Galloway, and Mädler agreed in method with Argelander, and their results were substantially in accordance with his and with Herschel's.

The following are the various right ascensions and declinations of the points towards which the solar motion is directed, according to these various authorities: —

Herschel	$A = 257°$	$D = +25°$
	$= 245\ 52'.5$	$+49\ 38'$
Argelander . . .	$= 259\ 51.8$	$+32\ 29.1$
Lundahl	$= 252\ 24.4$	$+14\ 26.1$
O. Struve	$= 261\ 23.1$	$+37\ 35.7$
Galloway	$= 257\ \ 4.4$	$+34\ 18.1$

Of the four latest determinations, that of Argelander is based upon the most stars. It is true that he finally employed but 390; but these are selected from a larger list of 560, and these again from the 3,222 of the Fundamenta Astronomiæ, as giving certain evidence of proper motion: while O. Struve employed 392 in all.

Argelander's 390 were observed by himself for the modern determination, and with very great accuracy.

Lundahl's investigation is based upon the 147 stars which Pond had observed, and Argelander not, and which exhibited proper motions exceeding 0″.09 yearly.

Galloway used 81 stars from the southern hemisphere; this investigation alone employs an old authority (Lacaille) independent of Bessel's Bradley.

A later investigation by Mädler takes account of the motions of all the stars (3,222 in number) found in the Fundamenta Astronomiæ of Bessel, as observed by Bradley near the epoch 1755. Mädler employs the same method of deducing the apex of solar motion as Argelander and the others; and his proper motions of the stars were obtained by himself from a discussion of all available observations. The task seems to have been too vast for his strength, as his proper motions are often erroneous; nor does he appear to have subjected the observations to the careful criticism which Argelander has always employed. Hence the errors of observation are often treated as proper motion by him, as happens more uniformly in the thoroughly worthless values contained in the British Association Catalogue; a work which has served a good purpose as a working-list, but in other respects has retarded rather than advanced our knowledge of star-places.

Mädler's results are: $A = 261° \ 38'.5$, $D = +39° \ 53'.6$.

All these discussions of the solar motion are based upon the apparent proper motions of the stars: these are caused by the real motions of both sun and stars; the latter element is considered to follow the law of casual error, and takes the place of error of observation in the discussion. The special method consists in assuming the pole of solar motion, determining from that in what direction each star should move if its own motion were zero, and comparing this direction with the observed; then, by the application of conditional equations and the method of least squares, corrections are found to the assumed pole.

II. To this process Sir George Airy objects: —

1. That we are not sure of even the rude accuracy of the first assumption.

2. Therefore our differential equations will not hold good.

3. And, if they did, the resulting error might change *per saltum* from $+179°$ to $-179°$ by a small change in the assumption; rendering it far from clear whether the method of least squares could properly be thus applied.

He suggests the employment of rectangular co-ordinates of the various stars, assuming their relative distances according to magnitude, as estimated by W. Struve. In this way he obtained the following positions of the point towards which the motion is directed: —

$$\left.\begin{array}{ll} A = 256^\circ\ 54', & D = 39^\circ\ 29' \\ = 261\ \ 29, & = 26\ \ 44 \end{array}\right\}, \text{ with different modes of treatment;}$$

and his assistant Dunkin, from more stars, the following: —

$$\left.\begin{array}{ll} A = 261^\circ\ 14'.0, & D = 32^\circ\ 55'.0 \\ = 263\ \ 43.9, & = 25\ \ \ 0.5 \end{array}\right\}, \text{ with Airy's two modes of treatment.}$$

The proper motions here employed are the Rev. R. Main's, derived from a direct comparison of the positions of the 12 and 6 year Greenwich Catalogues with Bessel's Bradley, and are consequently (upon the whole) more accurate than Mädler's, though not including so many stars. A good many of them are substantially equal to the similar values used by Argelander or Lundahl. Airy employed 113 and Dunkin 1,167 stars: the former set are those whose proper motions are the largest.

Kovalski has used a similar method, employing Mädler's proper motions, and assuming all the stars to be equidistant from the sun. His results were in general similar to those of previous investigators.

III. But unfortunately both Airy and Dunkin express still some doubt about the reality of the result; for the sum of squares of the observed motions is diminished by only one twenty-fifth part on the introduction of the solar motion; so that, although the accordance of the various positions of the pole of motion is gratifying, the suggestion is made by Dunkin that some improvement in our knowledge both of stellar proper motions and stellar distances is yet necessary.

IV. Meanwhile Argelander has within a few years collected the materials for discussing the proper motions of several hundred stars, mostly of the smaller magnitudes, which on this account had been previously overlooked. As the matter now stands, there are between fifty and sixty known stars whose annual proper motion is greater than 1″: not much more than half of these are visible to the naked eye. So that, it seems, magnitude is a very uncertain criterion of proper motion; and all the evidence shows that it is also an uncertain test of distance from us.

V. Some years ago I made the attempt to determine the solar motion from the 250 stars investigated by Argelander in the first part

of the 8th volume of the Bonn observations. Of all these, or nearly all, the proper motion was certain; of many it was large; six or seven of them only had been previously used in the problem.

In studying their motions, I grouped them by tens, assuming those to be equally distant whose proper motions in arc were nearest equal. My result for the apex was not very different from those which preceded; but there appeared indications that for each such group the average proper motion was inversely proportional to the average distance, or, in other words, that our assumptions of star-distances ought to depend upon proper motion.

VI. The method I used was substantially Airy's; but in working out the problem I employed a little device like one I have used to simplify the study of planetary orbits. I selected the point whose right ascension was 259° 50′.8, and whose declination was 32° 29′.1, as a point in the positive direction of the axis of Z; that of X I located in the equator, in right ascension 349° 50′.8, and that of Y in right ascension 79° 50′.8 and declination 57° 30′.9. Thus, so far as Argelander's apex is correct, the average stellar motion will be negative, along the axis of Z; all other motions will, upon the whole, counteract each other.

VII. So I found it, at least approximately; and, in addition, that the mean Z's for each group of ten were as nearly equal as their probable errors would lead us to expect, taking, as before stated, the proper motion of each star as the measure of the reciprocal of its distance.

VIII. The present paper is for the purpose of showing this relation with respect to the stars earlier investigated by Argelander, Lundahl, and Galloway.

The details of O. Struve's paper are not published, and his stars are largely identical with those of the others; Mädler's investigations have suffered, as before mentioned, from the many errors in his proper motions, which I have detected over large areas of the heavens, but which it will be impossible to get rid of without an investigation costing enormous labor. I propose to continue these investigations from time to time, as material for them accumulates: the great difficulty in the whole matter arises from the extremely unsystematic way in which it has been the fashion to observe star-places, and work up their results. So soon as the great co-operative zones now in progress are completed, much more will be known regarding proper motions; so that for the present what I give here may suffice. I should have added my previous results, but have not been able to get the papers from Chicago, owing to the illness of my assistant, who has had charge of them.

IX. Assuming for the moment that the apex of solar motion is known, and employing Argelander's notation; if now we compute

$$\cos \chi = -\sin D \sin \delta + \cos D \cos \delta \cos (\alpha - A),$$

$$\sin \psi' = \frac{\cos D \sin (\alpha - A)}{\sin \chi},$$

$$\Delta \varsigma \sin \psi = \Delta \alpha \cos \delta,$$

$$\Delta \varsigma \cos \psi = \Delta \delta;$$

(where α, δ, are the star's right ascension and declination,

A, D, the like co-ordinates of the apex,

χ the star's distance from the apex,

ψ' the angle of position at the star of the great circle passing through star and apex,

$\Delta \alpha$, $\Delta \delta$, the star's annual proper motion in right ascension and declination,

$\Delta \varsigma$ the same in arc of a great circle,

ψ the angle of position in which the star appears to move): then will each star give an equation $\zeta \sin \chi = r \Delta \varsigma \cos (\psi' - \psi)$.

Here ζ is the annual solar motion, and r the star's distance from the sun.

X. We shall now proceed as follows: —

Grouping together stars whose proper motions are nearly equal, and making *within such a group* $r \Delta \varsigma = 1$, we shall find from each group a value of ζ expressed in terms of $r \Delta \varsigma$, or $\frac{\zeta}{r \Delta \varsigma}$. If these values of $\frac{\zeta}{r \Delta \varsigma}$ for *widely* different values of $\Delta \varsigma$ are nearly equal, — as they proved to be in the preliminary investigation, — we may conclude that $r \Delta \varsigma$ is nearly constant over a wide range of values of $\Delta \varsigma$; or, in other words, that star-distances are on the whole inversely proportional to proper motions.

As the values of $\sin \chi$ vary greatly, it is proper to find $\frac{\zeta}{r \Delta \varsigma}$ from each group by least squares; and I have done so.

The formula used was $\frac{\zeta}{\Delta \varsigma} = \frac{\Sigma [\sin \chi \cos (\psi' - \psi)]}{\Sigma \sin^2 \chi}$

GALLOWAY'S SOUTHERN STARS.

Group.	No. Stars.	Greatest and least $\Delta\varsigma$	Value of $\frac{\varsigma}{r\Delta\varsigma}$
I.	10	8″581 — 0″540	0.582
II.	10	0.479 — 0.246	0.856
III.	10	0.244 — 0.194	0.723
IV.	10	0.190 — 0.150	0.723
V.	10	0.149 — 0.127	0.765
VI.	15	0.125 — 0.085	0.851

Galloway has 81 stars: I have omitted 12 of the 16 whose ancient places he derives from Bradley, as these are either in Argelander's or Lundahl's investigations, and not uniform with the rest as to the old position.

The 4 of these which are not contained in Argelander's or Lundahl's lists have proper motions ($\Delta\varsigma$) varying from 0″.122 to 0″.101, and give $\frac{\varsigma}{r\Delta\varsigma} = 0.992$.

ARGELANDER'S STARS.

Group.	No. Stars.	$\Delta\varsigma$		Value of $\frac{\varsigma}{r\Delta\varsigma}$
Class I.				
I.	10	5″13	1″33	0.666
II.	11	1.32	1.01	0.848
Class II.				
I.	10	0″98	0″79	0.447
II.	10	0.77	0.69	0.718
III.	10	0.68	0.57	0.389
IV.	10	0.57	0.53	0.611
V.	10	0.53	0.48	0.886

ARGELANDER'S STARS (*continued*).

Class III.

Group.	No. Stars.	Δs		Value of $\frac{\zeta}{r \Delta s}$
I.	9	0.49	0.46	0.909
II.	10	0.46	0.42	0.762
III.	10	0.42	0.40	0.962
IV.	10	0.40	0.38	0.907
V.	10	0.38	0.36	0.757
VI.	10	0.36	0.35	0.429
VII.	10	0.35	0.33	0.533
VIII.	10	0.33	0.32	0.684
IX.	10	0.32	0.30	0.647
X.	10	0.30	0.29	0.478
XI.	10	0.29	0.28	1.006
XII.	10	0.28	0.27	0.547
XIII.	10	0.27	0.26	0.455
XIV.	10	0.25	0.25	0.816
XV.	10	0.25	0.24	0.753
XVI.	10	0.24	0.23	0.719
XVII.	10	0.23	0.22	0.277
XVIII.	10	0.22	0.21	0.146
XIX.	10	0.21	0.21	0.312
XX.	10	0.21	0.20	0.613
XXI.	10	0.20	0.19	0.897
XXII.	10	0.19	0.18	0.637
XXIII.	10	0.18	0.17	0.257
XXIV.	10	0.17	0.17	0.530
XXV.	10	0.17	0.16	0.524
XXVI.	10	0.16	0.15	0.669
XXVII.	10	0.15	0.14	0.956
XXVIII.	10	0.14	0.13	0.589
XXIX.	10	0.13	0.12	0.309
XXX.	10	0.12	0.11	+0.785
XXXI.	10	0.11	0.10	—0.067
XXXII.	9	0.10	0.09	+0.869

Note. — I omitted from Class III., Group I., the star C. A., No. 167, which properly belongs in Class II., Group II., and would there change $\frac{\zeta}{r \Delta \zeta}$ to 0.762. The values of this quantity were computed with two decimals in $\sin^2 \chi$ and $\sin \chi$ as $(\psi' - \psi)$, and are not always sure to the third.

The stars investigated by Lundahl show less accordance. There are more of the stars with small proper motions ($0''.12 - 0''.09$), which appear to move not in accordance with the hypothesis of solar motion: I attribute this, in part at least, to the errors in Pond's and Bradley's observations, which, for this series, are less perfectly eliminated than for Argelander's.

LUNDAHL'S STARS.

Group.	Δs	No. Stars.	Value of $\frac{\zeta}{r \Delta s}$
I.	1″21 — 0″25	7	1.045
II.	0.23 — 0.19	10	0.474
III.	0.19 — 0.18	10	0.448
IV.	0.18 — 0.16	10	0.683
V.	0.16 — 0.15	10	0.839
VI.	0.15 — 0.14	10	0.740
VII.	0.14 — 0.13	10	0 622
VIII.	0.13 — 0.13	10	0.721
IX.	0.13 — 0.12	10	0.280
X.	0.12 — 0.11	10	0.871
XI.	0.11 — 0.11	10	0.072
XII.	0.11 — 0.11	10	0.815
XIII.	0.11 — 0.10	10	0.042
XIV.	0.10 — 0.09	10	0.514
XV.	0.09 — 0.09	10	0.695

For values of proper motion between 5″.13 and 0″.13 annually there is no constant deviation of the value $\frac{\zeta}{r \Delta \varsigma}$ from 0.666, or nearly $\frac{2}{3}$; but from 0″.13 to 0″.09, — that is, the smallest proper motions thought safe to use in the original investigations, — its value is about 0.46, with unusual fluctuations. The last value of each set is by some chance larger than 0.666.

The proper motion of each star being taken as unity, it will be diminished in every case by the amount

$$\cos^2 (\psi' - \psi) - \left[\cos (\psi' - \psi) - \frac{\zeta \sin \chi}{r \Delta \varsigma}\right]^2.$$

The first term, $\cos^2 (\psi' - \psi)$, denotes the square of the observed proper motion of each star in the direction of the great circle passing through the star and the apex of solar motion. This is the direction in which alone the proper motion is affected by the solar motion. The second term $\left[\cos (\psi' - \psi) - \frac{\zeta \sin \chi}{r \Delta \varsigma}\right]^2$ is the square of this component after the solar motion $\frac{\zeta}{r \Delta \varsigma}$ has been subtracted, projected upon the line passing through the star, in the plane passing through the star, apex, and the eye, perpendicular to the line of sight. The difference of these two squares is the proportionate part of the square of the proper motion thus allowed for; and for each star, making $\frac{\zeta}{r \Delta \varsigma} = x$, a constant is equal to

$$2 x \sin \chi \cos (\psi' - \psi) - x^2 \sin^2 \chi.$$

For all the stars we shall need to take the sum

$$2\,x\,\Sigma\,(\sin\chi\cos(\psi'-\psi)) - x^2\,\Sigma\sin^2\chi.$$

But,

$$\frac{\Sigma\,(\sin\chi\cos(\psi'-\psi))}{\Sigma\sin^2\chi} = x, \text{ or } \Sigma\,(\sin\chi\cos(\psi'-\psi)) = x\,\Sigma\sin^2\chi;$$

hence, for n stars the sum of squares n of proper motions, each taken equal to unity, will be diminished by $x^2\,\Sigma\sin^2\chi$, or about $0.24\,n$: as $x^2 = 0.38$, and the average $\sin^2\chi$ is about 0.64.

The conclusions I would draw from the investigations so far are these: —

1. In studying the solar motion, the distances must be assumed with reference to the amount of proper motion, and (approximately) in inverse proportion to it.

2. The smaller proper motions (0″.13 or less annually) need careful study at this time.

3. There is some hope of using the solar motion as a sort of base to advance our knowledge of stellar distances.

4. The parallaxes of all stars whose parallax exceeds 1″ annually (about 60 in number) should be systematically determined by a co-operative arrangement.

V.

HISTORICAL SKETCH OF THE GENERIC NAMES PROPOSED FOR BUTTERFLIES:

A CONTRIBUTION TO SYSTEMATIC NOMENCLATURE.

By Samuel H. Scudder.

Presented, Nov. 11, 1874.

Botanicus mihi hic dicitur is, qui genera naturalia observare intelligit. Botanici (nec minus Zoölogici) autem nomine indignum judico Curiosum, qui de generibus sollicitus non est. — Linné, *Philos. botan.*

Nomina si pereunt, perit et cognitio rerum. — Fabricius, *Philos. entom.*

Three years ago, in preparing my Systematic Revision of North American Butterflies, I first became fully aware of the extraordinary diversity of use of certain generic names in this group of insects; and I endeavored, by an historical study of the subject, to satisfy my own mind of the proper manner in which they ought to be used. The results of this study were published in the paper alluded to; but in only a few cases, and then in the briefest manner, was the process stated by which a conclusion was reached. A month or so before the issue of that paper, the late Mr. G. R. Crotch published in the Cistula Entomologica the results of an exactly similar study, based upon the same principles, but confined to an examination of those genera of butterflies which had been proposed previous to the publication of Hübner's Verzeichniss bekannter Schmettlinge. The process was in this case given, but, as it seems to me, by an unsatisfactory method, and one in which the individual opinion of the author often affected the result without the reader's cognizance.

My own paper was prepared under very unfavorable circumstances; and I therefore determined to revise its conclusions *de novo*, and to extend the study to the entire group of butterflies, as the only way in which accuracy and precision could be attained. The result is given in the present paper. The historical method is chosen as the most satisfactory one, the use of each generic name being traced from its first proposal down to the year 1874. The entire body of entomological

literature has been searched with great care, and it is believed that very little of importance has escaped examination: at the same time, so much only is published as seems necessary to an elucidation of the subject.

The plan pursued with each generic name in this essay is to give, in the first place, its date, author, and place of publication, and a list of the species first included in it. For the sake of uniformity and readier comparison, these specific names (as well as all subsequent specific names) are reduced to the nomenclature of the last general catalogue of butterflies,* without which it would have been nearly impossible to have undertaken this study with the hope of any satisfactory result. Where the specific name used by the author quoted differs from the one employed for the species by Kirby, it is placed in a parenthesis, after Kirby's name; thus, in quoting the species placed by Hübner under the generic name Brangas, we have: Caranus (Pelops, Caranus), Didymaon (Dydimaon), Syncellus, Bitias. The names, as given by Hübner, stand: Pelops, Caranus, Dydimaon, Syncellus, Bitias. As reduced to Kirby's nomenclature, they are: Caranus, Didymaon, Syncellus, Bitias, Hübner's first two species being considered as one. If one or more species are indicated as types by any author, these are stated.

In a similar way, the treatment of the group by the next author is given, whose action in any manner affects its boundaries; but, in this and in subsequent cases, complete lists of the included species are not quoted, but only such a statement given as is necessary for the case in point. Other references follow, as far as they are needed, in chronological order, the dates placed at the extreme left. The action of the different authors quoted is then criticised, conclusions drawn, and attention directed to the species, which, whether from the original author's action, or by the treatment of the name by subsequent writers, should be considered as typical. For readier consultation, they are also distinguished from others given in the primary list by the use of bold-faced type in those cases where the generic name stands, or of italics where it falls; often this is the only indication of my own judgment.

Generic names which cannot be used for butterflies are followed by an asterisk.

Where the name of an author occurs in brackets, it indicates that

* W. F. Kirby, A Synonymic Catalogue of Diurnal Lepidoptera, London, 1871, pp. 690.

the fact of authorship is not distinctly stated, but is gathered from the context, or from subsequent works.

Names of genera which contain no butterflies are introduced wherever their members were originally considered as butterflies by the founder.

With regard to the principles upon which this work has been undertaken, I adopt, in general, those regarding genera enunciated by Agassiz in the preface to his Nomenclator Zoölogicus, and more recently by Thorell, in his work on European Spiders, with such exceptions or modifications as are indicated in my canons of systematic nomenclature.* There are, however, a few points which need special mention.

Only those names are introduced which are connected with the binomial nomenclature founded by Linné: for this reason, the trinomials of Hübner and the terms applied by Linné himself to the groups into which he divided Papilio, as well as the similar terms used by other earlier writers, such as some of those of Fabricius, Herbst, etc., have been totally disregarded. All, or nearly all, the trinomials of Hübner (used principally in the first volume of his Sammlung Exotischer Schmetterlinge, and in his Systematisch-Alphabetisches Verzeichniss) are actually used by him in some work or other (as in the Tentamen or Franck's Catalogue) with a binomial application; and in those cases they are here introduced, but only dating from the time at which and for the species for which they were employed binomially. With regard to the so-called subgeneric appellations of Linné and others, such as Plebeius, Nymphalis, etc., there are but two views which, it seems to me, can consistently be taken of them: one, that these authors always used them in a trinomial or quadrinomial nomenclature, exactly similar to that of Hübner, such as Papilio Danaus candidus rapæ, — in which case they ought not to be adopted, or else candidus should demand the same right as Danaus; the other, that they should be retained as names of groups exactly as they were first used, at the head of divisions, in a plural form, — Plebeii, Nymphales, etc. Plural nouns as titles of groups, and singular nouns with a generic signification, cannot be derived from one and the same source. "Nomina generica cum classium et ordinum naturalium nomenclaturis communia, omittenda sunt." Now the early authors, in referring to the true "genera" of Linné, always used them, as Linné did, in a singular form; but when referring to the groups into which Papilio was divided, as groups, they always used them, as Linné did, in a

* Amer. Journ. Sc. Arts [3], iii. 348.

plural form. The heading of the butterflies was Papilio, not Papiliones; of the swallow-tails, Equites, not Eques.

That, if used at all, they should be retained in other than a generic sense, is abundantly shown by tracing the mode in which these groups of Linné, subordinate to the genus Papilio, became the divisions subsequently termed families, and more comprehensive than the genera of modern times. Even in the last century the term "families" was applied to them; for when Cramer, in 1779, in the introduction to the first volume of his great iconographic work, alluded to the classification of Linné, it was introduced in these terms: "Je donnerai ici les divisions de M. Linné, Papillons — cinq familles." Fabricius, when he first attempted in 1807 to subdivide the butterflies into numerous genera, retained the terms Papilio and Hesperia formerly used by him, greatly restricting them of course; but did not employ, in any form whatsoever, the group-names previously in use, whether those given by Linné or those established by himself, — with a single exception, where he divides Papilio into Trojaner and Achiver, just as the Equites (to which he restricts Papilio) had before been divided into Trojani and Achivi.

But it is to French writers that we must look for the greatest light upon this subject. In Cuvier's Tableau Élémentaire (1798) we find these groups of Linné, somewhat remodelled and placed under the two genera then in use, Papilio and Hesperia: the groups, as here modified, represent in the main the families of modern times. It was during the activity of Latreille that the old genera began to be more and more restricted and new genera to multiply, until, before his death and through his writings, the interrelationship of genera and families among butterflies was entirely reversed; "families" having formerly been considered divisions of "genera," while "genera" were now looked upon as divisions of "families." In the first edition of Cuvier's Règne Animal (1817), Latreille placed all the butterflies under one "genus," Papilio, subdivided into groups termed "subgenera," which, though differing greatly from the divisions of Linné, must really be considered modifications of them, brought gradually about by the progress of science; a few, too, of Linné's names are retained. In 1825, in his Familles Naturelles, the butterflies are divided into many "genera," corresponding very closely to his previous subgeneric divisions, and ranged under one "family," Diurna, exactly corresponding to Linné's Papilio. In this connection, a study of the numerous changes in classification introduced by Latreille in his different works is very instructive. I have entered into these particulars, because Messrs. Kirby and Crotch have recently endeavored to carry back

some of the Latreillean genera to Linné's time, and even to insist, for the first time, upon the necessity of employing Plebeius and similar words in a generic sense and of accrediting them to Linné. It may be added that some of these subordinate names of Linné are used in what I deem to be their true signification, as names of groups, in my Systematic Revision.

Other subsidiary principles, which are employed in this essay, should be stated. A generic name founded upon that of any species intended to be included therein, or of any synonyme of such species, must fall; and if any name falls, from this or from any other cause, it should be dropped altogether in zoölogy. I have here adopted the views of biologists who allow the repetition of names in its two departments of zoölogy and botany, but no further. And no attempt has been made to discover whether the older name (under which another may fall) is in actual use or not, since in the ever-changing sentiment among naturalists, of the generic limitation of groups, this is practically impossible, and would lead to the instability of nomenclature. The author, department, and date of publication of the older name before which any generic appellation falls, has been given, whenever possible, in order that any person may, if he choose, follow out any reference for himself, here as elsewhere. If a species is designated as type of a genus whose name cannot stand, it retains that significance when a new generic name is proposed to supplant it.

By thus calling the attention of naturalists to *historical facts* (which they may interpret in any way they judge best), I hope to have done something toward introducing some degree of fixity, logic, and precision in the generic nomenclature of the group under consideration. More perhaps than any other class of animals, unless we except Mollusca, butterflies have suffered from the writings of uneducated naturalists: and it is impossible, such has become the multiplicity of names, to reduce to order the chaotic mass of facts, excepting through their patient collation and chronological exposition. If other facts are discovered by which the result is affected, they can at once be brought into proper collocation; if a wrong interpretation is given, it is the more readily seen and pointed out. The method is clear and precise, although tedious and painful in the extreme; and such is the interrelation of usage among certain names, and the heterogeneous nature of others, as often to render the study very perplexing. The result reached in some cases will surprise many entomologists, as it has myself, and in not a few instances I would gladly see a logical way out of the necessity of change among names which have had long

usage; but the law of priority is, and would best be, inexorable, and the action of those who decry it would relegate our nomenclature to an increasingly chaotic condition. I therefore hold to it as of the utmost importance in nomenclature, as the very foundation of its stability. The changes now required by its strict application are solely due to its neglect in the past. No thought of objection would arise, if it were not so. Entomologists more than others have neglected this law, have frequently acted in defiance of it, and upon them its application falls, as we should expect, most severely. A strict surveillance of systematic work hereafter will render the future, it may be hoped, less fruitful in blunders than the past.

As the work is based upon a chronological order of facts, some remarks are necessary upon two points: the dates of Hübner's different works, and that of Doubleday and Westwood's Genera. The date of Hübner's Sammlung Exotischer Schmetterlinge has generally been given as 1806–37, the years during which it is supposed to have been issued. But a careful study of the internal and external evidence shows that the dates may be much more closely approximated in all cases. The first volume contains only and all those plates to which a trinomial nomenclature is appended, and with which, as such, we have here nothing to do. The third volume, or continuation of Hübner's work, must be attributed to Geyer, and dated after Hübner's death in 1826. Hübner's Index of 244 plates (including about one hundred and seventy-five species of butterflies), in which he applies a binomial nomenclature to all the species of his first volume, is dated December, 1821, and must have been published shortly after the commencement of his second volume; for he includes in the Index twenty-one species of this volume. Supposing the plates recorded in the Index, and therefore published from 1806 to 1821 inclusive, to have been issued at regular intervals, the first volume must have been completed at about the close of 1819. We may therefore, in default of more precise data, fix upon 1806–19 as the date of the first volume, 1820–21 as that of the plates of the second recorded in the Index, and 1822–26 of those not so recorded.

This work, however, is not the only one of Hübner's which requires close examination. The Verzeichniss is dated 1816, and has always been referred to under that date. But internal evidence positively disproves this, and on that account Ochsenheimer's and Dalman's works of 1816 ante-date it. The title-page and preface to Hübner's work, the latter bearing the date 21 Sept., 1816, were printed, as the paging and signature-mark show, at the same time as the first

ten pages of the catalogue itself; that is, they form a part of the first signature. But the preface to the first century of the Zuträge, which bears date 22 Dec., 1818, directly refers to a work of this nature as an unpublished desideratum. Further than this, not only are all the butterflies of the first century of the Zuträge referred to by number in the Verzeichniss,* but a species figured in the second century (Lycus Niphon (Nos. 203–4) is referred to both by name and number in the Verzeichniss, page 74. Now the preface to the second century bears the date 23 Dec., 1822. If we consider this the date when the plates of that part were completed, as is probable, then we must make the same supposition of the first century, viz., — the very end of 1818; and hence page 74 of the Verzeichniss, or, in other words, its fifth signature, and all following it, could not have been printed before two years after the Verzeichniss is dated. On page 312 of the Verzeichniss are references by number to the Zuträge, Nos. 395–6 and 429–30 the former on the last page of the second century, and the latter on the twelfth page of the third century, which dates from 27 Aug., 1825. Supposing, as before, that the preface of each part was not printed until the engraving of its plates was completed (which makes the least discrepancy), we cannot put an earlier date to page 312, or the twentieth signature, than 1823. It is questionable whether we can be so lenient as this; for it is stated by Geyer in Thon's Archiv (I. 29–30) that Hübner prepared Franck's Catalogue late in 1825. In this sale catalogue (p. 100) a list of the works of Hübner and other entomologists is given with prices annexed; and among them appear eighteen signatures (Bogen) of the Verzeichniss, probably all published at that time. We may therefore fairly conclude that, while this work was commenced in 1816, it was issued in signatures; that by the end of 1818 only the first five signatures were printed, and by the end of 1822 only the first twenty. More probably, however, only the first eighteen signatures were printed before the autumn of 1825. The work was completed by Hübner and wholly published by 1827, judging from Geyer's list of Hübner's works given in Thon's Archiv † (l. c.). Doubtless a

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* Excepting only Nos. 193–4, which are not referred to at all; and a few of the later ones, which are referred to by name only, — viz., Nos. 163–4 on page 9 of the Verzeichniss, 187–8 on page 11, 188–90 on page 80, and 197–8 on page 47.

† The price of the work is given there as 44 kreutzers only, while that of the Syst.-alph. Verzeichniss, not one-fifth its size, as 54 kreutzers. This may probably be accounted for by the greater rarity of the latter, rather than by an incomplete condition of the former.

nearer approach could be made toward the dates of the different parts of the book by a comparison of the moths with those of the Zuträge. These facts are given to show that the whole work could not have been published in 1816. Still, for mere convenience and uniformity, I have used 1816 as the date; for the only case where the dates conflict with those of another writer in the use of the same generic name is that of Eurybia, which should unquestionably be referred to Illiger.

The preceding statement also shows that the dates of the different parts of the Zuträge are probably correct.

The Tentamen* is undated. It is twice referred to by Hübner himself: once in the preface to his Verzeichniss, written in 1816; and again, in 1818, in the preface to the first century of his Zuträge. In the latter case it is not specified by name, but the substance of it is reprinted, and there is no other work of Hübner's to which his words can refer; it is stated to have been published in 1806. It is also referred to by Ochsenheimer in 1816, in the preface to the fourth volume of his Schmetterlinge Europas, as having been unknown to him at the time of the publication of the first volume of the same work, in 1807; it is also included by Geyer in his list of Hübner's works, and by Hagen in his Bibliotheca Entomologica.

I am greatly indebted to Dr. Hagen, of Cambridge, and to Herr Gerichtsrath Keferstein, of Erfurt, for their kind assistance in my endeavor to discover the dates of Hübner's works. It would be a worthy task, if one of the Berlin entomologists would examine the works of Hübner in the Königliche Bibliothek, where, I am told by Dr. Hagen, they are preserved in their original wrappers.

There is still another work, the dates of the different parts of which, as given here, require explanation. Doubleday and Westwood's Genera of Diurnal Lepidoptera was published in parts, and Mr. B. P. Mann has shown me a nearly complete set of the work in the original wrappers; although it is the reissue and not the original edition, a careful comparison of its divisions with the dates printed at the bottom of many of the signatures, convinces me that the reissue was purely a reissue, and that the plates accompanying each part of the text are the same as in the original issue. The dates given below are based upon this supposition.

The dates of different parts of such of Boisduval's works as appeared by livraisons are drawn from the official literary bulletin published in Paris at that time, and can be relied upon for accuracy.

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* Republished by me in fac-simile. Cambridge, 1873.

References to Leach in Brewster's Encyclopædia are to the paging in the American edition; all the references to Hewitson's Exotic Butterflies are at second-hand.

In conclusion, I would return my thanks to many entomologists who have answered special inquiries concerning works and insects to which I had no ready access; and especially to Mr. W. F. Kirby, of Dublin, and the late Mr. G. R. Crotch, of Cambridge, with whom I have constantly consulted, and whose aid has been of the greatest importance.

1. ABÆIS.

1816. Hübn., Verz. 97: Nicippe, **Cebrene** (Arethusa), Brigitta.
1870. Butl., Cist. Ent. i. 35: designated Nicippe as type.
1872. Scudd., Syst. Rev. 39: does the same.

Nevertheless Nicippe cannot be taken as the type, for that species must be reserved for Xanthidia (1829). The other species referred to it belonging to the genus Eurema (1816), Cebrene may be taken as the type.

2. ABANTIS.

1855. Hopff. Verh. Akad. Wissensch. Berl. 643: **tettensis**. Sole species, and therefore type.

3. ABISARA.

1860. Feld., Wien. Ent. Monatschr. iv. 397: **Echerius** (Kausambi), Savitri, Damajanti.
1867. Bates, Journ. Linn. Soc. Lond., Zoöl. ix. 413: extends the genus, but includes in it only the former two of the original species.

Echerius may be considered the type.

4. ABROTA.

1858. Moore, Cat. Lep. E. Ind. Co. i. 176: **Mirus** (Ganga). Sole species, and therefore type.

5. ACAPTERA.

1820. Billb., Enum. Ins. 76: **crisia**. Sole species and designated type.

6. ACCA.

1816. Hübn., Verz. 44: Melicerta (Blandina), Agatha, Columella (Columena), aceris (Matuta, aceris), Sappho (Lucilla), **Venilia**, Heliodora, Lucothoe, Ophione, Valentina, Sulpitia, Hera.

1865. Herr.-Schaeff., Prodr. i. 66: confines the genus to two species, Procris and Urdaneta, not mentioned at all by Hübner, nor very closely related to the original types, but placed by Kirby in the genus Limenitis. They have therefore nothing to do with Acca.

Felder in his Neues Lepidopteron divides the genus Neptis into seven sections, the fifth containing the species Venilia. It is to this group that I would restrict Hübner's generic name Acca, with Venilia for type. See Procris.

7. Acentrocneme.

—— Feld. MS., in a copy of Feld., Lep. Fragm. 46: **Kollari.** Sole species, and therefore type.

Proposed by the author, in a copy of his work sent to Frauenfeld, as a substitute for Ægiale (q. v.) preoccupied. I do not find it published anywhere.

8. Achalarus.

1872. Scudd., Syst. Rev. 50: **Lycidas.** Sole species and designated type.

9. Achillides.

1816. Hübn., Verz. 85: Bianor, **Paris**, Helenus, Severus, Deiphobus (Deiphobus, Alcandor), Agenor* (Achates, Alcanor).

Paris may be considered as the type.

10. Achlyodes.

1816. Hübn., Verz. 107: Busiris (Busiris, Bucolus), Thraso, **Fredericus** (Fridericus).

1852. Westw., Gen. Diurn. Lep. 524: employs it for several species, including, of Hübner's, all excepting Busiris.

1869. Butl., Cat. Fabr. Lep. 285: employs it for several species, including, of Hübner's, only Busiris.

1870. Ib., Ent. Monthl. Mag. vii. 98: designates Busiris as type, but wrongly, on account of Westwood's action.

1872. Scudd., Syst. Rev. 50 [Achylodes]: does the same, with similar error. See also Helias.

The three species placed by Hübner in this group belong to as many genera; and therefore, as Thraso was taken as type of Eantis (q. v.) in 1836, Fredericus must be the type of this.

11. Achna.*

1820. Billb., Enum. Ins. 80: proposed for Helias, for no reason whatever. Helias (q. v.) falls for lack of members.

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* Placed also by Hübner, in the same work, in Iliades.

12. ACIDALIA.

1816. Hübn., Verz. 31: Cybele, Aglaia (Aglaja), Adippe, Niobe, **Niphe.**

1850. Steph., Cat. Br. Lep. 13, 258: uses the name for the three middle species, Aglaja, Adippe, Niobe.

1858. Kirb., List Br. Rhop.: employs it for the same and others.

These, however, as well as Cybele, all belong to the earlier Argynnis. Niphe may therefore be taken as the type.

13. ACOLASTUS.

1872. Scudd., Syst. Rev. 50: **Savignyi.** Sole species and designated type. See Polygonus.

14. ACONTHEA.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. (expl. plates): Adonia (Lubentina), Alankara, Aconthea (primaria).

1829–30. Ib., Zoöl. Journ. xvii. 65: Cocytina, Coresia (Apaturina), Nero (Thyria).

Being founded upon the name of one of the species included in the group,* the name falls, and cannot properly be used; moreover, the name Acontia (Hübn., Lep. 1816) is, perhaps, too closely allied. See Adolias.

15. ACONTIA.*

1847–48. Westw., Cab. Or. Ent. 76, pl. 37: *Siva* (Doubledayi). Sole species, and therefore type.

The species has, however, been made the type of the genus Neurosigma (q. v.), and the generic name is preoccupied in Lepidoptera (Hübn. 1816).

16. ACRÆA.

1807. Fabr., Ill. Mag. vi. 284: **Horta,** Terpsichore, Bellona (Brassolis).

The first two species are Acræans, as understood in recent times; the last, however, is a Pierid.

1816. Hübn., Verz. 92: places five species under this generic name, none of which have any thing whatever to do with the Fabrician group; most of them are Pierids. His genus Telchinia corresponds in general to the Fabrician Acræa. Later authors have retained the Fabrician name for this group.

1872. Crotch, Cist. Ent. i. 66: specifies horta as type.

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* The first citation is undoubtedly the earlier.

17. Acrophthalmia.

1861. Feld., Wien. Ent. Monatschr. v. 305 [Acrophtalmia]: **Artemis.** Sole species, and therefore type.

1867. Ib., Reise Novara, 486: corrects the name to Acrophthalmia, and it is so used by Kirby.

18. Actinote.

1816. Hübn., Verz. 27: Thalia, Gea (Epæa), **Euryta** (Eurita), Amosis (Amesis).

1848. Doubl., Gen. Diurn. Lep. 142: retains it for Thalia and seven others, placed in two sections.

1869. Butl., Cat. Fabr. Lep. 128: employs it for Thalia only.

Nevertheless Thalia cannot be designated as the type (see Calornis); nor can Amosis, because it was placed in Alesa in 1847. Euryta may be taken as the type.

19. Aculhua.

1871. Kirb., Syn. Cat. Lep. 301: **Cinaron.** Sole species, and therefore type.

The name is proposed in place of Dryas Feld., nec Boisd., nec Hübn.

20. Adelpha.

1816. Hübn., Verz. 42: **Mesentina,** Basilea (basilis), Iphicla, Plesaure, Cocala, Cytherea (Elea, Cytherea), Phliasus (Phliase).

1865. Herr.-Schaeff., Prodr. i. 66: employs it for Irmina and five others, of which only Mesentina (Mesenteria) is mentioned by Hübner.

1871. Kirb., Syn. Cat. Lep. 230: employs it for all the species mentioned by Hübner and Herrich-Schaeffer, excepting the last of Hübner's, which is wrongly placed in this connection.

Mesentina may be designated as type.

21. Adolias.

1836. Boisd., Spec. gén., plates 3, 4 B.: **Aconthea** [larva only], Dirtea (Boisduvalii).

1844. Doubl., List Br. Mus. 102: places a number of species in the genus, among them Aconthea.

1850. Westw., Gen. Diurn. Lep. 289: places twenty-five species in the genus, among them Aconthea, which he specifies as type.*

1861. Feld., Neues Lep. 34: divides the genus into ten sections, the first of which he names Itanus, and places in it Aconthea and four others. See Aconthea.

22. ADOPÆA.

1820. Billb., Enum. Ins. 81: **Thaumas** (linea) and a MS. species.

Thaumas is therefore the type See Pelion.

23. ÆGIALE.*

1860. Feld., Wien. Ent. Monatschr. iv. 110: *Kollari*. Sole species, and therefore type.

This generic term is too close to Ægialia (Latr., Col. 1807); and probably for this reason in a copy of the Lepidopterologische Fragmente in my possession the name is erased, and Acentrocneme (q. v.) substituted.

24. ÆMONA.

1868. Hewits., Exot. Butt. iv. 64: **Amathusia.** Sole species, and therefore type.

25. ÆOLA.*

1820. Billb., Enum. Ins. 78: Iris, Ilia, Bolina (Lascinassa, Bolina), and a MS. species.

No matter which species is chosen as the type, the genus is preoccupied. See Apatura and Potamis.

26. AERIA.

1816. Hübn., Verz. 9: Nasica, Reckia (Reckii), **Aegle,** Eumelia (Vocula), assarica (asarica).

The first species is a moth, and Eumelia is very distinct from the others.

1844. Doubl., List Br. Mus. 149: places six species in this group, among which are Aegle and Reckia of Hübner's list.

1847. Ib., Gen. Diurn. Lep. 126: places four species in the group, of which Aegle is the only one of the original species of Hübner's.

Aegle then should be the type. See Choridis.

* It may seem out of place to some to consider a species as type, when reference is originally made to the larva only; but the entire force of the objection is lost, when we remember that generic distinctions are as easily traced in the larva as in the imago.

27. ÆRODES.

1820. Dalm. in Billb., Enum. Ins. 79: **Idomeneus.** Sole species, and therefore type.

If, however, this species is strictly congeneric with Eurylochus, the genus will fall before the earlier Caligo (q. v.).

28. ÆROPETES.*

1820. Billb., Enum. Ins. 79: Licus (Licas), Tulbaghia.

There is a Castnian with the name of the first species, and it is probably the insect meant by Billberg, although the species is Drury's, and not Fabricius's, as stated by the writer. The group as thus constituted consists of wholly incongruous material, and may be discarded. See Meneris.

29. ÆTHEIUS.

1816. Hübn., Verz. 109: Pretus, **Archytas,** Meris.

Archytas may be selected as type, although belonging to a different family from the other two; for it alone belongs to the group in which Hübner placed this genus.

30. ÆTHILLA.

1868. Hewits., Hesp. 55: **Eleusinia.** Sole species, and therefore type.

1870. Butl., Ent. Monthl. Mag. vii. 57: designates Eleusinia as type.

31. AGANISTHOS.*

1836. Boisd., Spec. gén., pl. 4 B.: *Odius* (Orion). Sole species, and therefore type.

Used in same sense by subsequent authors. Probably, however, it must fall before Historis (q. v.)

32. AGAPETES.

1820. Billb., Enum. Ins. 78: **Galathea,** Lachesis.

Galathea may be taken as type. See Melanargia, Satyrus, and Arge.

33. AGATHINA.*

1843. White, Zoöl: i. 28: *Margaretta.* Sole species, and therefore type.

The name is, however, preoccupied in mollusks (Raf. 1831).

34. AGERONIA.

1816. Hübn., Verz. 42: Amphinome, Arethusa (Laodamia), Feronia, **Chloe.**

Subsequent usage has been in accordance with this.

1861. Feld., Neues Lep. 17: divides the genus into four sections, the fourth of which, unnamed, contains only the last species mentioned by Hübner.

Chloe may therefore be considered as the type. See Peridromia.

35. AGLAIS.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 56, 64: Io, Antiopa, Polychloros, **urticæ**, c. album, Atalanta, cardui; urticæ specified as type.

1872. Scudd., Syst. Rev. 16: also specifies urticæ as type.

36. AGLAURA.*

1851. Boisd. in Westw., Gen. Diurn. Lep. 327: Westwood gives this as a MS. synonyme of Zeuxidia (q. v.).

It is preoccupied in Acalephs (Pér.-Les. 1809) and Worms (Sav. 1817).

37. AGRAULIS.

1833–4. Boisd.-LeC., Lép. Am. Sept. 142: **vanillæ**. Sole species, and therefore type.

1836. Boisd., Spec. gén., pl. 6 B.: Moneta.

1861. Feld., Neues Lep. 7: separates two sections, the first including vanillæ and Juno, the second Moneta.

38. AGRIADES.

1816. Hübn., Verz. 68: Endymion (Daphnis), Laius (Cajus), Panoptes, Argiolus, Ladon, Admetus, **Orbitulus**, Corydon, Dorylas (Dorylas, Golgus), Thetis (Adonis), Alexis (Agestis), Chiron (Eumedon), Icarus (Icarius).

1850. Steph., Cat. Br. Lep. 19, 261: places in it Corydon, Thetis (Adonis), Alexis, Dorylas, and Icarus (Icarius, Eros).

1858. Kirb., List Br. Rhop.: places in it Argiolus, Corydon, Alexis (Agestis), and Artaxerxes (Salmacis, Artaxerxes).

The species mentioned by Stephens and Kirby seem to belong to the earlier Rusticus, and hence have no effect. Orbitulus may be taken as the type.

39. AGRIAS.

1844. Boisd. in Doubl., List Br. Mus. 106: **Claudia**, Blomfildia (Blomfildia, bella).

1848. Boisd. MS. by Doubl. in Hewits., Proc. Zoöl. Soc. Lond. xvi. 45: Ædon.

1850. Westw., Gen. Diurn. Lep. 298: Claudia, Ædon. He credits Boisduval with the name, but restricts the group to one of his MS. sections.

1870. Boisd., Lép. Guat. 52: claims the name, and refers Ædon to it.

1871. Kirb., Syn. Cat. 265: uses it for Claudia, Ædon, and others.

Claudia may be considered as the type through Westwood. The name is rather close to Agria, used in Diptera (Rob.-Desv. 1830).

40. Agrodiætus.

1825. Hübn., Catal. Franck, 82: Semiargus (acis), Cyllarus (Damœtas), Argiolus, Iolas, **Damon**, Endymion (Daphnis), Arcas (Erebus), Corydon, Orbitulus, Icarius, Dorylas, Thetis (Adonis), Icarus (Alexis), Argus, Hylas, Optilete, Argiades (Polysperchon), Bœticus, roboris (Evippus), Virgaureæ, Gordius, Thersamon, Phlæas, Ballus, Hippothoe (Chryseis), Alciphron (Hipponoe), Spini, Strephon (Sicheus), Quercus, W. album, ilicis (Lynceus), Beon, Eurytulus, Hemon (Hemon, Acmon), Atys, Marsyas, betulæ (betuli), imperialis (Venus), Helius (Eurisus).

Damon may be taken as the type.

41. Aides.*

1820. Billb., Enum. Ins. 81: Epitus (Epithus), Phocus (Phocas), Proteus.

This name is preoccupied through Aidos (Hübn., Lep. 1816).

42. Ailus.*

1820. Billb., Enum. Ins. 81: proposes, without reason, to use this name for Zelima (q. v.).

43. Ajantis.

1816. Hübn., Verz. 13: **Sappho**, Antiochus (Antiocha), Pasithoe (Hecale).

Sappho, which is generically distinct from the others, may be taken as the type.

44. Alæna.

1847. Boisd., Voy. Delag. ii. 591: **Amazoula**. Sole species, and therefore type.

45. Alazonia.*

1816. Hübn., Verz. 46: Cydippe, Cyane (Penthesilea, Simbiblis).

Unless Cyane should prove generically distinct from Cydippe, as scarcely seems probable, this name must fall before Cethosia (q. v.).

46. Alcidis.*

1860. Feld., Wien. Ent. Monatschr. iv. 250: *Liris*. Sole species, and therefore type.

But the name is preoccupied in Lepidoptera (Hübn. 1816). [See Appendix, p. 293.]

47. Alcyoneis.*

1816. Hübn., Verz. 35: Asterie, Almana (Almane).

This name falls before Junonia of the same author, both its species being generically identical with those of Junonia.

48. Alesa.

1847. Doubl., List Br. Mus. 1: Amosis (Priolas), **Prema.**

Subsequent authors (Westwood, Bates, Kirby) having always placed Prema first on the now more extended list of species, it may be considered as type.

49. Algia.*

1865. Herr.-Schaeff., Prodr. i. 77: *Satyrina*. Sole species, and therefore type.

But the species is inedited and the genus undescribed, its place only indicated as between Lachnoptera and Messaras; consequently the name must be dropped.

50. Allotinus.

1865. Boisd. in Feld., Reise Novara, 285: **Fallax**, major, subviolaceus, unicolor, albatus.

The first species being the only one credited to Boisduval, that must be considered the type.

51. Alœides.

1816. Hübn., Verz. 73: Thyra, **Pierus.**

Pierus may be taken as the type.

52. Amarynthis.

1816. Hübn., Verz. 26: **Meneria** (Menaria). Sole species, and therefore type.

The genus has always been used in this sense.

53. Amaryssus.*

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 60, 85: *Machaon*. Sole species and designated type.

1820. Billb., Enum. Ins.: applies it wrongly to other swallow-tails.

But Machaon had earlier been specified as type of Princeps, and therefore this genus falls, and cannot again be employed. See Papilio.

54. Amathusia.

1807. Fabr., Ill. Mag. vi. 279: **Phidippus.** Sole species, and therefore type.

It has always been used in this sense. See Mitocerus.

55. Amauris.

1816. Hübn., Verz. 14: **Niavius** (Niavia), Egialea, Echeria.

1866. Reak., Proc. Acad. Nat. Soc. Philad. 33: uses it in the same sense, adding another species.

1871. Kirb., Syn. Cat. 8: employs it similarly.

Niavius may be considered as the type.

56. Amblygonia.*

1865. Feld., Reise Novara, 308: Eumæus (Agathon), Amarynthina.

Falls before Notheme, and is preoccupied (Herr.-Schaeff., Lep. 1855).

57. Amblypodia.

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 98: I. Narada; II. Vivarna; III. **Apidanus**, Centaurus, Ædias (Helus), Eumolphus; IV. Phocides (Sugriva); V. Vulcanus, Lohita, Syama, Timoleon (Rochana), Jalindra, Longinus, Erylus, Jangala, Vidura, Etolus.

1847. Doubl., List Brit. Mus. 23: uses it for Narada, Apidanus, Centaurus (Pseudocentaurus), Eumolphus, Timoleon (Rochana), Longinus, Jangala, Vidura, and others which are mostly MS. species.

1852. Westw., Gen. Diurn. Lep. 477: employs it for all these and others, specifying Centaurus, Apidanus, Ædias (Helus), and Anthelus — the last only not previously mentioned — as the types.

1868. Herr.-Schaeff., Prodr. ii. 18: gives Narada and two others.

1870. Boisd., Lép. Guat. 14: specifies Narada as the type, but incorrectly, through Westwood's previous limitation.

1871. Kirb., Syn. Cat. 419: employs it for a large number of species, including the four types mentioned by Westwood.

Apidanus may be taken as the type.

58. AMBLYSCIRTES.

1872. Scudd., Syst. Rev. 54: **vialis**, Hegon (Samoset), Tolteca. The first species specified as type.

59. AMECERA.*

1867 (March). Butl., Ann. Mag. Nat. Hist. [3] xix. 163: *Megæra* (Megæra, Lyssa), Tigelius, Mæra, Eversmanii, Hiera, Schakra (Shakra), Menara, Baldiva.

The author says that Dira of Hübner "cannot be adopted, as it includes several distinct forms, the type species moreover being a true Lasiommata."

1867 (June). Ib., Entom. iii. 280: Megæra.

1868. Ib., Ent. Monthl. Mag. iv. 195; Cat. Sat. 123: specifies Megæra as the type.

The name must fall before Lasiommata (q.v.), unless some of the species first mentioned by Butler should prove to be generically distinct from Megæra; this is hardly probable. Dira of Hübner contains representatives of three different genera, and can be retained for one of them.

60. AMECHANIA.*

1861. Hewits., Exot. Butt. ii. 87: *incerta*. Sole species, and therefore type.

1861. Herr.-Schaeff., Ex. Schm. pt. 39: incerta. The genus is to be credited to Hewitson, since Herrich-Schaeffer does so in his Prodromus.

The genus, however, according to Butler, is strictly congeneric with Zethera, which has precedence by one month. Amechania must therefore drop, and cannot again be employed.

61. AMMIRALIS.*

1832. Renn., Consp. 10: *Atalanta*. Sole species, and therefore type.

The genus falls before Vanessa. See also Pyrameis and Bassaris.

62. AMNOSIA.

1844. [Boisd. in] Doubl., List Br. Mus. 88: **decora**. Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 259: makes the same use of it, but accredits the generic name to Boisduval, in whose name it must therefore stand. See Leptoptera.

63. AMPHICHLORA.

1861. Feld., Neues Lep. 19 [as section of Ageronia]: **Feronia** (Feronia, Epinome), Ferentina, Fornax.

1865. Herr.-Schaeff., Prodr. i. 76: Chloe. The generic name is credited to Boisduval!

Feronia may be taken as the type.

64. AMPHIDECTA.

1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 404: **pignerator.** Sole species, and therefore type.

65. AMPHIDEMA.

1861. Feld., Neues Lep. 27: **Beckeri.** Sole species, and therefore type.

66. AMPHIRENE.*

1844. Doubl., List Br. Mus. 86: Trayja (Traja), *Epaphus.*

1848. Ib., Gen. Diurn. Lep., pl. 32: Epaphus.

1870. Boisd., Lép. Guat. 43: Epaphus (Epaphea) and others.

This name falls before Siproeta (q. v.).

67. AMPHRISIUS.*

1832–33. Swains., Zoöl. Ill. ii. 98: *Pompeus* (Nymphalides).

Amphrisius is one of the synonymes of this species; and the generic name being founded upon it falls, and cannot be employed. See Troides.

68. AMYCLA.*

1849. Doubl., Gen. Diurn. Lep. 223: *Taurione* and three more to which a query is attached; namely, Orphise (Orphise Triphosa), Amycla, and Cœlina.

It is employed for Taurione and another species by Felder (Neues Lepid.); but, being founded upon the name of one of the species originally included in it, it falls, notwithstanding that Doubleday expressly says that the species Amycla may belong to Cybdelis.

69. AMYNTHIA.

1832–33. Swains., Zoöl. Ill. ii. 65: Chlorinde (Swainsonia), **Maerula** (Merula); type specified as Mærula.

1847. Doubl., Gen. Diurn. Lep. i. 70: proposes that it should be used for the American species placed by him in Gonepteryx, which includes both of the above. (See also Rhodocera.)

1870. Butl., Cist. Ent. i. 35, 45: indicates Chlorinde (Swainsonia) as type, but of course erroneously.

This generic name must be retained, because Anteos (q. v.) is virtually preoccupied.

70. Anadebis.

1867. Butl., Ann. Mag. Nat. Hist. [3] xix. 50: **Himachala.** Sole species, and therefore type, as subsequently indicated by the same writer. See also Theope.

71. Anæa.

1816. Hübn., Verz. 48: **Troglodyta** (Troglodita), Morvus (Laertias, Acidalia), Leonida, Rhipheus (Riphea). The last is not a butterfly.

Troglodyta may be taken as the type.

72. Anaphæis.

1816. Hübn., Verz. 93: **Creona,** Chloris, Java (Coronea).

Creona may be taken as the type.

73. Anartia.

1816. Hübn., Verz. 33: Arsinoe, **Jatrophæ,** Amalthea (Amathea).

1849. Doubl., Gen. Diurn. Lep. 214: divides the group into two sections, in the first of which he places Jatrophæ and in the second Lytrea (Lytræa), and others, including Amalthea (Amathea); the group is equivalent, he says, to Boisduval's MS. genus Celæna (see Celœna).

Felder adopts the same division, and we may therefore restrict the group to the first division, and consider Jatrophæ as the type.

74. Anastrus.

1822–26. Hübn., Ex. Schm. ii.: **Corbulo** (obscurus). Sole species, and therefore type.

This may stand, though it is worth stating that Hübner had previously (Verz. 1816) placed this species in two other and different genera. See Celænorrhinus and Talides.

75. Anatole.

1816. Hübn., Verz. 24: **Zygia,** Penthea.

These two species not being congeneric, and this generic term having been retained by different authors, such as Doubleday, Westwood, Bates, Kirby, for the first species, it may be considered as the type.

76. Anchyphlebia.*

1868. Butl., Ent. Monthl. Mag. iv. 195: *Archæa.* Sole species, and specified type.

Falls before Antirrhea (q.v.); Butler's objection to Antirrhea, that it was not characterized by its author, may be urged just as strongly against many of Boisduval's genera, accepted by him.

77. Ancistrocampta.

1862. Feld., Wien. Ent. Monatschr. vi. 183: **Hiarbas** (Syllius). Sole species, and therefore type, as stated subsequently by Butler.

78. Ancyloxypha.

1862. Feld., Verh. zoöl.-bot. Gesellsch. Wien, xii. 477: **Numitor,** corades. Numitor is specified as type.

1872. Scudd., Syst. Rev. 53: also specifies Numitor as type.

79. Ancyluris.

1816. Hübn., Verz. 23: Tedea, **Aulestes** (Pyrete), Periander (Periandra).

Kirby (Syn. Cat.) has used this term in the place of Erycina (preoccupied), placing in it the first two species, which are not congeneric, and others.

Tedea belongs to Zeonia (1832–33), Periander was taken in 1837 as the type of Diorina, and hence Aulestes must be taken as the type. See Rodinia.

80. Andropodum.

1825. Hübn., Catal. Franck, 84: cratægi, **Ilaire** (Margarita), Lycimmia (Limnoria), Monuste? (Pseudomonuste), Pyrrha (Eieidias), Eucharis, Tereas, Eurota, [?] Buniæ (Endeis), cheiranthi, brassicæ, napi (napi, bryoniæ), Callidice, Anguitia, Daplidice, Belemia, Ausonia (Belia, Ausonia), Eupheno, cardamines, sinapis (lathyri), Phiale, Albula, Elathea, Delia (Daira), Nise, Croceus (Edusa), Chrysotheme, Hyale, Phicomene, Palæno, Argante (Hersilia), Philea, Eubule (Eubule, Sennæ), Cipris (Cypris), Statira (Evadne), Cleopatra, rhamni, and a MS. species.

Ilaire may be taken as the type.

81. Anelia.

1822–26. Hübn., Exot. Schmett. ii.: **Numida** (Numidia). Sole species, and therefore type.

1827–37. Gey. in Hübn., Exot. Schmett. iii.: Thirza. See Clothilda and Synalpe.

82. Anemeca.

1871. Kirb., Syn. Cat. 179: **Ehrenbergii.** Sole species, and therefore type. See also Morpheis.

83. Anops.*

1836. Boisd., Spec. gén., pl. 7 C.: *Thetys* (Phædrus). Sole species, and therefore type.

Since used by Doubleday and Westwood, but the name is preoccupied in Crustacea (Oken, 1815), and Reptiles (Bell, 1833). See also Curetis and Phædra.

84. Anosia.

1816. Hübn., Verz. 16: Erippus (Archippe, Erippe), Misippus (Misippe), **Gilippus** (Menippe, Vincedoxici, Eresima).

As Misippus is totally distinct from the other species of this genus as well from the group to which it belongs (having been placed here on account of its mimetic resemblance), it can in no case be considered or made the type of the genus; the other species not being strictly congeneric, and Erippus being already excluded, from its relation to Danaida, Gilippus must be taken as the type.

85. Anteos.*

1816. Hübn., Verz. 99: rhamni, Mærula, Cleopatra.

This name must be dropped, from its too close resemblance to Anteon (Jurine, Hym. 1807). See Amynthia and Colias.

86. Anteros.

1816. Hübn., Verz. 77: **formosus**, Achæus.

It has since been used (Doubleday, Westwood, Bates, Kirby) in the same sense. Formosus may be taken as the type.

87. Anthene.*

1847. Doubl., List Br. Mus. 27: Galathea, Larydas.

This term is too close to Anthenea (Gray, Echin. 1840) to be employed.

88. Anthocharis.

1836. Boisd., Spec. gén. 556: I. Belemia (Belemia, Glauce), Ausonia (Belia, Ausonia, Simplonia), Tagis, Eupheno, Damone, cardamines, **Genutia**; II. chilensis; III. subfasciata; IV. Evanthe, Eucharis, Evarne, Danæ, Eupompe, Achine (Antevippe, Achine), Antigone, Evippe, Omphale, Theogone, Etrida, Phlegetonia, Delphine, Eione, Daira, Evagore, Ephyia (Ephya), Liagore, Eulimene, Arethusa, Cebrene, Ocale.

1847. Doubl., Gen. Diurn. Lep. 56: places in Anthocharis (sens. strict.) ten species, including Belemia and Genutia.

As Euchloe (q. v.) must be used for the European species, Genutia may be considered the type of this genus. See also Midea.

89. Anthomaster.

1872. Scudd., Syst. Rev. 57: **Leonardus**, Uncas. Leonardus specified as type.

90. Anthopsyche.

1857. Wallengr., Rhop. Caffr. 10: I. **Achine**, Omphale, Evenina, Procne, Phlegetonia, Gavisa; II. Eupompe, Danæ, Evarne, Eucharis, Agoye, Eris, Ione (Jone, speciosa).

We propose restricting this group to the first section, with Achine as type. For the second section, see Callosune.

91. Anthora.*

1844. Doubl., List Br. Mus. 99: *Eurinome*. Sole species, and therefore type.

This generic name falls before Euxanthe, and is preoccupied in Crustacea (Leach, 1813). See also Godartius.

92. Antigonis.*

1861. Feld., Neues Lep. 21: *Pharsalia*. Sole species, and therefore type. Used subsequently by Herrich-Schaeffer and Kirby in the same sense.

This name is preoccupied in several ways by the following names: Antigonus (Hübn., Lep. 1816), Antigona (Schum., Moll. 1817), and Antigonia (Lowe, Fishes, 1844). Kirby has proposed the name Lincoya (q. v.) for this group.

93. Antigonus.

1816. Hübn., Verz. 108: **Nearchus** (ustus), Erosus.

1870. Butl., Ent. Monthl. Mag. vii. 98: designates Nearchus as the type. See also Chætoneura.

94. Antirrhea.

1822–26. Hübn., Exot. Schmett. ii: **Archæa**. Sole species, and therefore type.

1844. Doubl., List Br. Mus. 121: Archæa, Philoctetes.

1851. Westw., Gen. Diurn. Lep. 365: uses it in the same sense.

1868. Butl., Ent. Monthl. Mag. iv. 195; and Cat. Satyr. 107: gives Philoctetes as type, but of course erroneously.

He afterwards founded the genus Anchyphlebia upon Archæa, because Hübner's genus was not characterized; but see remarks under Anchyphlebia.

1871. Kirb., Syn. Cat. 38: uses the genus in its proper sense.

95. Apatura.

1807. Fabr., Ill. Mag. vi. 280: Iris, **Bolina**, Alimena.

In 1806, Hübner (Tent.) selected Iris as type of Potamis; consequently Apatura must be restricted to the other two, which are congeneric, and Bolina may be taken as the type. This, however, is not in accordance with subsequent usage, as will be seen by the following: —

1815. Leach, Edinb. Encycl. 718: gives Iris only.

1816. Ochs., Schmett. Eur. iii. 19: gives Iris and Ilia; but he was restricted to these from the nature of the case.

1816. Hübn., Verz. 35: uses it for Bisaltide and a number of others, none of which have any thing to do with the Fabrician members of the genus.

1831. Curtis, Brit. Ent., pl. 338: designates Iris as type.

1832. Dup., Pap. France, Diurn. Suppl. 402: uses it for Iris and Ilia.

1833–4. Boisd.-LeC., Lép. Am. Sept. 206: refer Idyia (Clyton) and celtis to it.

1837. Sodoffsk., Bull. Mosc. x. 81: proposes to spell it Apaturia.

1840. Westw., Gen. Syn. 87: specifies Iris as type.

1844. Doubl., List Br. Mus. 108: refers to it Iris, Ilia, and Clyton.

1850. Westw., Gen. Diurn. Lep. 302: regards Iris and Ilia as types.

1861. Feld., Neues Lep. 36: divides the group into six sections, to the first of which he gives the name of Apatura *par excellence*, with Iris, Ilia, and Namouna (Ambika) as species.

1871. Kirb., Syn. Cat. 259: uses it in the extended Felderian sense, arranging the species in the same order.

1872. Crotch, Cist. Ent. i. 66: says Iris is type, on account of Ochsenheimer's limitation, overlooking the work of his own countryman, Leach.

This result is from want of familiarity with Hübner's Tentamen. See also Esoptria, Æola, Hypolimnas, Diadema, and Potamis.

96. Apaturia.*

1837. Sodoffsk., Bull. Mosc. x. 81: proposes this name as an etymological correction for Apatura (q. v.).

97. Apaturina.

1865. Herr.-Schaeff., Prodr. i. 75: **Erminea.** Sole species, and therefore type.

98. Apaustus.

1816. Hübn., Verz. 113: **Menes.** Sole species, and therefore type.

Butler and Kirby use it subsequently in the same sense.

99. Aphacitis.

1816. Hübn., Verz. 19: Lusca, **Lucinda** (Dyndima).

Lusca, though Hübner's species, was not published until after his death, and hence we must take Lucinda as the type. See Nelone.

100. Aphantopus.*

1853. Wallengr., Lep. Scand. Rhop. 30: *Hyperanthus*. Sole species, and therefore type.

Falls before Hipparchia (q. v.).

101. Aphnæus.

1816. Hübn., Verz. 81: Vulcanus, **Orcas.**

1847. Doubl., List Brit. Mus. 25: employs it for a number of species, including both of Hübner's.

1858. Horsf.-Moore, Cat. Lep. E. Ind. Co. i. 37: employ it for both Hübner's species and others.

Herrich-Schaeffer, Butler, and Kirby also use it for both of Hübner's species with others. Orcas may be taken as type.

102. Aphrissa.

1873. Butl., Lep. Exot. 155: **Statira.** Sole species and designated type.

103. Aphrodite.*

1816. Hübn., Verz. 95: Evippe, Danæ (Eborea).

This name is preoccupied by Aphrodita (Linn., Worms, 1735). See Callosune.

104. Apodemia.*

1865. Feld., Reise Novara, 302: Mormo, virgulti (Sonorensis).

This name also is preoccupied by Apodemus (Kaup, Mammals, 1825).

105. Aporia.

1816. Hübn., Verz. 90: **cratægi.** Sole species, and therefore type.

It has frequently been used (Stephens, Wallengren, Staudinger, Westwood) in the same sense. See Leuconea and Pieris.

106. Apostraphia.

1816. Hübn., Verz. 13: Ricini, Bellona (Brassolis), **Charithonia** (Charitonia).

Bellona (not a Heliconian at all) was placed here by error. Charithonia may be taken as type.

107. Appias.

1816. Hübn., Verz. 91: **Zelmira**, Achine.

As Achine is needed as type of Anthopsyche, Zelmira may be considered the type of this group.

108. Aprotopos.* [Aprotopus in Index.]

1871. Kirb., Syn. Cat. 19: Ædesia, Ceto, Melantho, Pytho.

Ædesia being the necessary type of Xanthocleis, this name must fall, unless one of the other species should prove generically distinct.

109. Araschnia.

1816. Hübn., Verz. 37: **Levana** (Levana, Prorsa). Sole species, and therefore type.

110. Arcas.*

1832–33. Swains., Zoöl. Ill. ii. 88: *imperialis*. Sole species, and therefore type.

Must this name fall before Evenus? (q. v.)

111. Archon.

1822. Hübn., Syst.-Alph. Verz.: Machaon (Machaon, Sphyrus), Medisicaste, Mnemosyne, Phœbus, Podalirius (Podalyrius), Polyxena, Rumina, **Apollinus** (Thia).

Apollinus may be taken as the type. See Doritis.

112. Archonias.

1825. Hübn., Zutr. iii. 19: **Tereas** (Marcias). Sole species, and therefore type. See Euterpe.

113. Aresta.

1820. Dalm. in Billb., Enum. Ins. 79: Amestris, Idalia, Ariadne, Asterie, Cloantha, **Laomedia**.

Laomedia may be selected as the type of this genus.

114. Arge.*

1816. Hübn., Verz. 60: occitanica (Psyche), Arge (Amphitrite), Thetis (Inis), Russiæ (Clotho), Lachesis, Galathea.

This generic term has been used largely by subsequent authors (Boisduval, Duponchel, Stephens, Doubleday, Westwood, Rambur, etc.), always in nearly the same sense; and Butler and Grote even cite occitanica (Syllius Butl., Psyche Grote) as the type; but the name cannot stand: first, because founded upon a name used for one of the original species; and, second, because preoccupied in Hymenoptera (Schrank, 1801). See Agapetes and Melanargia.

115. Argus.*

1764. Geoffr., Hist. des Ins. ii. 61: employs the term *Les Argus* at the head of a division of blues; but it can have no weight as a generic name, because it is used simply as a French word, as *Les Estropiés* is for the next division, of skippers.

1777. Scop., Introd. 432: employs it for more than fifty species, having no common and distinctive structural bond; they are divided into four sections, all of them almost equally heterogeneous in composition, each, excepting the last, containing members of every family of butterflies excepting the Urbicolæ. The name must therefore be dropped, and not be employed again in any sense. [The species Argus was not included in the genus by Scopoli.]

Boisduval also uses it in his Species général, but is not followed in this use by many other authors.

1816. Lam., Hist. Nat. An. sans Vert. iv. 21: employs it for Argyrognomon (vulgaris), Corydon, and others. One of the synonymes of Argyrognomon is Argus, so that if it be considered that the name was founded anew in this instance, it must be dropped, because based on a specific name.

1832. Dup., Pap. de France, Diurn. Suppl. 388: Battus and many others.

1832. Boisd., Icon. 49: employs it for the blues of Europe, appending his own name as authority!

1832. Ib., Voy. Astrol. 90: Cleotas (Poeta).

1833. Ib., Nouv. Ann. Mus. Hist. Nat. ii. 171: Lysimon.

1833–34. Boisd.-LeC., Lép. Amér. Sept. 113: Hanno (Filenus), etc.

1838–39. Krause, Faun. Thur. 60: uses it for Blues and Coppers.

1872. Scudd., Syst. Rev. 6: wrongly attempts to revive the name, calling Eurydice, one of Scopoli's species, the type.

116. Argynnina.

1867. Butl., Ann. Mag. Nat. Hist. [3] xix. 165: **Hobartia**, Lathoniella.

1868. Ib., Ent. Monthl. Mag. iv. 196: Hobartia specified as type.

117. Argynnis.

1807. Fabr., Ill. Mag. vi. 283: I. Paphia, Maia (Cynara), Laodice (Cethosia), **Aglaja**; II. Liriope, Tharos (Morpheus), Hermes.

1810. Latr., Consid. 440: specifies Paphia and Cinxia as types; but Paphia, the only one of these specified by Fabricius, cannot be the type, because already the type of Dryas (q.v.).

1815. Leach, Edinb. Encycl. 717: restricts it to the first of the Fabrician sections.

1815. Oken, Lehrb. i. 734: gives it the same restriction, as have all subsequent authors.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 57, 66: I. Paphia, Aglaja, Adippe, Niobe, Lathonia (Latonia); II. Aphirape, Selene, Euphrosyne, Amathusia, lapponica (Freja), Pales, Dia, Chariclea (Carichlea), Frigga, Ino, Thore. Adippe specified as type, but of course erroneously.

1816. Hübn., Verz. 30: Aphirape and its allies.

1820. Oken, Lehrb. f. Schulen, 790: Aglaja only.

1830. Curtis, Brit. Ent., pl. 290: specifies Aglaja as type.

1840. Westw., Gen. Syn. 88: wrongly specifies Paphia as type.

1872. Scudd., Syst. Rev. 24: specifies Aglaja as type.

1872. Crotch, Cist. Ent. i. 66: again specifies Paphia as type. See also Argyronome.

118. Argyrea.*

1820. Billb., Enum. Ins. 77: vanillæ, Lathonia, Niobe, Adippe, Aglaia (Aglaja), Paphia, Maia (Cynara), Niphe, Phalanta [?] (Pharantha), Aphirape, Selene, Euphrosyne, Pales, Gersenii, Ino, Thore, Amathusia, lapponica (Freja), Frigga.

This term is preoccupied by Argyreus (Scop., Lep. 1777) and Argyria (Hübn., Lep. 1816).

119. Argyreus.*

1777. Scop., Introd. 431: Niphe and twenty-six others in two sections, the former of which is divided into five, and the latter into three subsections; but they are all brought together in such a confused manner, and formed of such utterly incongruous material, even to what must have been the sense of the naturalists of his own day, that the genus must fall into merited oblivion. Subsection *c* of section *A* contains, for example, the following species among others: Rumina [Papilionides], vanillæ [Nymphales], and Cupido [Rurales].

120. Argyronome.

1816. Hübn., Verz. 32: Lampetia, Phalanta (Columbina), **Laodice**, Paphia, Maia (Pandora), Hostilia (Orthosia).

1850. Steph., Cat. Br. Lep. 13, 258: uses it for Paphia, Aphrodite, and Cybele; but Paphia, the only one of Hübner's species, is the type of Dryas.

Should Laodice prove generically distinct from the species of the genera Dryas and Argynnis, this name may be reserved for it; otherwise it will fall.

121. Argyrophenga.

1848. Doubl., List Br. Mus., App. 31: **antipodum.** Sole species, and therefore type.

Used in this sense by subsequent writers.

122. Argyrophorus.

1852. Blanch., Gay's Chili, vii. 30: **argenteus.** Sole species, and therefore type.

So used by Butler.

123. Arhopala.

1832. Boisd., Voy. Astrol. 75: **Phryxus.** Sole species, and therefore type.

124. Ariadne.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co., expl. pl.: *Ariadne* (Coryta). Sole species, and therefore type.

1833. Boisd., Ann. Mus. Nat. Hist. 201: specifies Merione and Coryta as types.

But, being founded upon the name of its original species, the generic name must be dropped, and not be brought again into use. It is, moreover, preoccupied in Arachnids (Sav. 1825). See Ergolis.

125. Aricoris.

1851. Boisd. in Westw., Gen. Diurn. Lep. 449: Cepha (Epitus), **Tisiphone**, Tutana, Constantius, Theanus.

1868. Bates, Journ. Linn. Soc. Lond. ix. 456: employs it for Cepha (Epitus) and others.

1871. Kirb., Syn. Cat. 332: uses it in the same sense as Bates.

Cepha, however, cannot be taken as type, for in 1856, through Pandemos, this became the type of Boisduval's genus Orimba; nor Theanus, for this is the type of Trichonis (1865); Constantius is too far removed from the others to be looked upon as at all typical, so that the choice remains, notwithstanding the action of Bates and Kirby, between Tisiphone and Tutana. We propose that Tisiphone be considered the type, since it is illustrated by Westwood.

126. Arisba.*

1847. Doubl., List Br. Mus. 11: *Agacles*. Sole species, and therefore type.

Preoccupied by Arisbe (Hübn., Lep. 1816).

127. Arisbe.

1816. Hübn., Verz. 89: **Leonidas** (similis), Panope.

Leonidas may be taken as the type.

128. Armandia.

1871. Blanch., Comptes Rend. lxxii. 809: **Thaidina**. Sole species, and therefore type. See Bhutanitis.

129. Arotes.*

1851. Boisd. in Westw., Gen. Diurn. Lep. 450: given by Westwood as a MS. synonyme of Setabis (q. v.).

130. Arpidea.*

1837. Dunc., For. Butt. 180: *Chorinæa*. Sole species, and therefore type.

This name must fall before Cærois (q. v.), and not be used again. See also Hames.

131. Arteurotia.

1872. Butl.-Druce, Cist. Ent. i. 112: **tractipennis**. Sole species and designated type.

132. Artipe.*

1870. Boisd., Lép. Guat. 14: *Eryx* (Amyntor) specified as type.

But the generic name is preoccupied by Artipus (Schönh., Col. 1826). See Deudorix.

133. Ascanides.

1837. Gey. in Hübn., Zutr. v. 32: **Triopas**. Sole species, and therefore type.

134. Ascia.

1777. Scop., Introd. 434: cratægi, napi, sinapis, **Monuste**, Polybe.

With the exception of the last species, which belongs to the Rurales, the genus is comparatively homogeneous, — the only one of Scopoli's of which this can be said, — and it should therefore be retained for one of the groups included in it. See Mylothris.

1816. Billb., Enum. Ins. 79: gives this name to a number of species belonging to the Nymphales, using Scopoli's name at the same time as the author!

1872. Scudd., Syst. Rev. 40: restricts the name to Monuste, and correctly; for Aporia removed cratægi from this genus in 1816, and Leptidia, sinapis in 1820. Polybe belongs to a different family, and must be passed over; and napi cannot be used, as it is needed for Pieris (q. v.).

135. Asterope.

1816. Hübn., Verz. 66: Amulia, **Sapphira** (Sapphyra), Theanus (Theane).

Sapphira may be taken as type. See Callithea.

136. Astictopterus.

1860. Feld., Wien. Ent. Monatschr. iv. 401: **Jama,** Sindu.

1870. Butl., Ent. Monthl. Mag. vii. 95: specifies Jama as type.

137. Astraptes.

1816. Hübn., Verz. 103: Corytas (Corytus), Pervivax, Narcosius, Apastus, Enotrus, Creteus, Mercatus (Fulgurator), **Aulestes**, Amyntas (lividus).

Aulestes may be taken as the type.

138. Astycus.

1825. Hübn., Catal. Franck, 85: Peleus, Mercatus (Fulgerator), vitreus, Simplicius, Proteus? Evadnes, Exadeus? Thraso, erosus, Tryxus, orbifera (orbifer?), oileus, Carthami, alceæ (malvæ), Morpheus (Steropes), Crinisus, **Augias,** Actæon, Thaumas (linea), Arsalte (Menalcas), Talaus, Phyllus, and a MS. species.

1869. Herr.-Schaeff., Prodr. iii. 45, 54: suggests its employment, but does not indicate its membership.

Peleus, Mercatus, Vitreus, Proteus, Thraso, Morpheus, Thaumas, and Arsalte are specified as types of other genera. Augias may be taken as the type of this, since it is the only one of the true Astyci* not already confined to a generic name which will hold.

139. Atalopedes.

1872. Scudd., Syst. Rev. 57: **Huron,** campestris. Huron specified as type.

140. Atella.

1847. Doubl., Gen. Diurn. Lep., pl. 22: **Phalanta** (Eurytis). Sole species, and therefore type.

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* Cf. Bull. Buff. Soc. Nat. Sc. i. 195.

1848. Ib., ib. 165: Phalanta (Eurytis) and five others in three sections.

As the figured species appeared six months before the text, it must be considered the type of the genus, as indeed it has been virtually treated by subsequent writers. The name is rather close to Atela (Dej., Col. 1833). See Phalanta and Messaras.

141. ATERICA.

1833. Boisd., Ann. Mus. Hist. Nat. 195: **Rabena.** Sole species, and therefore type.

Used in same sense by all subsequent writers.

142. ATHENA.

1816. Hübn., Verz. 36: **Peleus** (Thetis). Sole species, and therefore type.

According to Kirby (Syn. Cat. 220), this name is preoccupied, but he does not state where. See also Petreus.

143. ATHESIS.

1847. Doubl., Gen. Diurn. Lep. i. 109: **Clearista.** Sole species, and therefore type.

144. ATHIS.*

1816. Hübn., Verz. 101: *Palatinus.* It is not a butterfly.

145. ATHYMA.

1850. Westw., Gen. Diurn. Lep. 272: **Leucothoe,** Aceris (Eurynome), Heliodora (Helicopis), Sulpitia (Strophia), opalina, Sankara, Larymna, Venilia, Saclava, Vikasi, Nefte, Inara, Melaleuca, Brebissonii.

1861. Feld., Neues Lep. 32: divides the group into two sections, the first containing Leucothoe and Larymna, the second Nefte, Inara, and Sulpitia (Strophia).

1865. Herr.-Schaeff., Prodr. i. 67: uses it for Leucothoe and Larymna only.

Leucothoe as the older species may be considered as the type.

146. ATHYRTIS.

1862. Feld., Wien. Ent. Monatschr. vi. 413: **Mechanitis.** Sole species, and therefore type.

Used in same way by Herrich-Schaeffer and Kirby.

147. Atlides.

1816. Hübn., Verz. 80: **Halesus** (Halesus, Dolichus), Polybe (Atys, Scamander).

1869. Butl., Cat. Fabr. Lep. 197: uses it in the same sense.

Halesus may be considered as the type.

148. Atrophaneura.

1864. Reak., Proc. Ent. Soc. Philad. iii. 446: **Semperi** (Erythrosoma). Sole species, and therefore type.

149. Atrytone.

1872. Scudd., Syst. Rev. 56: **Iowa**, Logan, conspicua, Zabulon. Iowa specified as type.

150. Augiades.

1816. Hübn., Verz. 112: crinisus, Arcalaus, comma, **sylvanus**, Helirius, Euribates.

1850. Steph., Cat. Brit. Lep. 23, 263: uses it for sylvanus, comma, Vitellius.

1858. Kirb., List Brit. Rhop.: uses it for Vitellius only, but this is not congeneric with either sylvanus or comma.

1870. Butl., Ent. Monthl. Mag. vii. 58: overlooking the restriction of Stephens, calls crinisus the type.

1872. Scudd., Syst. Rev. 58: designates sylvanus as the type.

See Erynnis.

151. Aulocera.

1867. Butl., Ent. Monthl. Mag. iv. 121: **Brahminus**, Saraswati, Padma (Padma, Avatara), Scylla.

1868. Ib., Cat. Sat. 49: specifies Brahminus as type.

Is this name too near Autocera (Melly, Col. 1857)?

152. Aurotis.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 63, 90: **quercus**, betulæ, pruni, w. album, ilicis.

It is given as a subgenus of Zephyrus, of which betulæ is type.

1863. Kirb., List Eur. Butt. 8: roboris (Evippus). [See also p. 293.]

The last three of Dalman's species belonging to Thecla (q. v.) after the foundation of Zephyrus, quercus must be taken as the type of Aurotis, if it is generically distinct from betulæ; if not, Aurotis falls.

153. Austromyrina.*

1865. Feld., Reise Novara, 260: Evagoras, Ictenus (Schraderi).

This name falls before Jalmenus.

154. AUTOCHTON.

1823. Hübn., Zutr. ii. 13: **Itylus.** Sole species, and therefore type.

155. AUTODEA.*

1850. Boisd. MS. in Westw., Gen. Diurn. Lep. 253: stated by Westwood to be synonymous with Hübner's Lucinia, as used in the Genera of Diurnal Lepidoptera. Of course it died at its birth.

156. AUTONEMA.*

1850. Boisd. in Westw., Gen. Diurn. Lep. 266: Westwood states that this is a MS. synonyme of Prothoe (q. v.).

It is nowhere else referred to.

157. AXIOCERSES.

1816. Hübn., Verz. 72: **Perion.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 337 [Axiocerces]: uses it for Zeuxo and many others, including Perion. But see his Preface.

158. BÆOTIS.

1816. Hübn., Verz. 21: **Hisbon** (Hisbæna), Eumeus (Uranis).

1847. Doubl., List Brit. Mus. 11: uses it for Hisbon and others, not including Eumeus.

1851. Westw., Gen. Diurn. Lep. 451: divides the group into two sections, and in the second places Hisbon. Eumeus is not given.

1867. Bates, Journ. Linn. Soc. Lond. ix. 444 [Bœotis]: uses it for Hisbon and three others. Hisbon therefore becomes the type.

159. BARBARUS.*

1872. Crotch, Cist. Ent. i. 60: refers this name, in a generic sense, to Linné, but remarks that it has not been accepted, because heterogeneous.

It does not seem to me to have ever been used, even by Linné, in a generic sense.

160. BARBICORNIS.

1823. God., Encycl. méth. ix. 705: **basilis.** Sole species, and therefore type.

Used in same sense by Westwood, Bates, and Kirby. Is it a butterfly? See Chroma.

161. Basilarchia.

1872. Scudd., Syst. Rev. 8: Archippus (Disippe), **Astyanax**, Artemis (Arthemis). Type specified as Astyanax.

See also Callianira.

162. Bassaris.*

1816–21. Hübn., Exot. Schmett. ii.: *Itea.* Sole species, and therefore type.

1821. Hübn., Index, 4: Itea.

The name falls before Vanessa (q. v.). See also Ammiralis and Pyrameis.

163. Batesia.

1862. Feld., Wien. Ent. Monatschr. vi. 112: **Hypochlora.** Sole species, and therefore type. See also Pandora.

164. Battus.*

1777. Scop., Introd. 433: Polydamas and a great number of wholly unrelated species, divided into six sections.

The utterly heterogeneous nature of this group may be shown by noticing a few of the species from the first section, such as Polydamas [Papilionides], Antiopa [Nymphales], Tespis [Rurales], and malvæ [Urbicolæ]. Of course the name must be dropped in perpetuity; moreover, Scopoli included in this group a species which he called Argus, but which the Therisianer called Battus, and the name should drop from this cause; nevertheless: —

1858. Ramb., Cat. Lep. Andal. 85: uses it for Sao.

This was not even one of the many original species, although (almost necessarily !) closely allied to some of them.

165. Belenois.

1816. Hübn., Verz. 92: **Calypso.** Sole species, and therefore type, as specified by Butler (Cist. Ent. i. 37, 50).

166. Bhutanitis.*

1873. Atk., Proc. Zoöl. Soc. Lond. 570: *Lidderdali.* Sole species, and therefore type.

Falls, according to Kirby (in litt.), before Armandia.

167. Bia.

1816. Hübn., Verz. 51: **Actorion** (Actoriæna). Sole species, and therefore type.

Used in same sense by Westwood, Herrich-Schaeffer, and Kirby.

168. Biblis.*

1807. Fabr., Ill. Mag. vi. 281: Biblis, Leucothoe, Nauplia, Neærea.
1819. God., Encycl. méth. 325: employs it for Biblis (Thadana) and others.
1836. Boisd., Spec. gén., pl. 5 B.: uses it for Aganisa, closely allied to Biblis.

Falls from having been named after one of the species on which it is founded. See Zonaga.

169. Bicyclus.

1871. Kirb., Syn. Cat. 47: **Hewitsonii**, Iccius, Italus, Zinebi.
1873. Ib., Zoöl. Rec. for 1871, 363: specifies Hewitsonii as type.

Correctly, since it was the type of Idiomorphus (q. v.), which this supplants.

170. Bithys.

1816. Hübn., Verz. 75: Erix (Tyrrhenus), Cupentus (Cubentus), Cethegus, Vesulus, **Strephon** (Sicheus, Strephon), Lydus, Tephraeus, Leucophaeus, Sphinx, quercus.
1850. Steph., Cat. Brit. Lep. 17: uses it for quercus.
1858. Kirby, List Brit. Rhop.: uses it in the same way.
1869. Butl., Cat. Fabr. Lep. 186: employs it for Strephon, Cyllarus, Agrippa, and Dindymus.

The usage of Stephens and Kirby is indefensible, as quercus must belong to Aurotis. In accordance with Butler's action, Strephon may be taken as the type.

171. Bletogona.

1867. Feld., Reise Novara, 465: **Mycalesis.** Sole species, and therefore type, as specified by Butler (Cat. Sat.).

172. Brachycneme.*

1869. Herr.-Schaeff., Prodr. iii. 52.

No species are cited, and the name is preoccupied by Brachycnemis (Schönh., Col. 1844).

173. Brachyglenis.*

1862. Feld., Wien. Ent. Monatschr. vi. 73: *Esthema.* Sole species, and therefore type.

According to Felder (ib. 235), the name is preoccupied (Brachyglene, Lep., Herr.-Schaeff.*). See Tmetoglene.

* I have not been able to find any such generic name in the works of Herrich-Schaeffer; nor is Mr. A. R. Grote, to whom I referred the question, acquainted with it. It is not given in Marschall's Nomenclator Zoölogicus.

174. Brangas.

1816. Hübn., Verz. 80: **Caranus** (Pelops, Caranus), Didymaon (Dydimaon), Syncellus, Bitias.

1869. Butl., Cat. Fabr. Lep. 196: uses it for Thales, Caranus, Didymaon.

Caranus may be taken as type.

175. Brassolis.

1807. Fabr., Ill. Mag. vi. 282: **Sophoræ**, cassiæ, Obrinus.

1816. Hübn., Verz. 50: uses it for Darius (Anaxerete), and others, including Sophoræ and cassiæ.

1823. God., Encycl. méth. 456: employs it for Sophoræ and the allied Astyra.

1851. Westw., Gen. Diurn. Lep. 341: indicates Sophoræ as type.

1871. Crotch, Cist. Ent. i. 66: does the same.

176. Brenthis.

1816. Hübn., Verz. 30: **Hecate**, Ino (Dictynna), Thore, Daphne, Claudia.

1861. Feld., Neues Lep. 10: divides the group in two sections, specifying no species for the first, and for the second Pales and Cytheris.

1865. Herr.-Schaeff., Prodr. i. 73: gives Cytheris (Siga, Cytheris) and others, including none of Hübner's, all but the last of which are placed in Arygnnis.

1872. Scudd., Syst. Rev. 24: indicates Hecate as type.

177. Brontiades.

1816. Hübn., Verz. 113: **Procas**, Gentius, Arsalte (Menalcas) Petrus.

1870. Butl., Ent. Monthl. Mag. vii. 94: designates Procas as type.

178. Butleria.

1871. Kirb., Syn. Cat. 624: Polyspilus, **exornatus**, Agathocles, Cypselus, Caicus, Cœnides, dimidiatus, Polycrates, Epiphaneus, Hesperioides, aureipennis, bisexguttatus.

1873. Ib., Zoöl. Rec. for 1871, 365: specifies exornatus as type.

See also Carterocephalus.

179. Byblia.

1816. Hübn., Verz. 28: **Ilithya.** Sole species, and therefore type. See also Hypanis.

180. Cabirus.

1816. Hübn., Verz. 102: Linus, **Julettus.**

Linus is not a butterfly, and Julettus may be taken as the type.

181. Cæcina.

1868. Hewits., Hundr. Hesp. 55: **Calathana,** compusa.

Calathana may be considered as the type.

182. Cærois.

1816. Hübn., Verz. 56: **Chorinæus** (Arcesilae). Sole species, and therefore type, as stated by Butler (Cat. Sat. 1).

1851. Westw., Gen. Diurn. Lep. 366: the same.

1865. Herr.-Schaeff., Prodr. i. 63 [Cærous]: the same.

See Arpidea and Hames.

183. Calaides.

1816. Hübn., Verz. 86: **Androgeos** (Polycaon, Androgeus, Piranthus), Menatius.

Androgeos may be taken as the type.

184. Calais.*

1836. Boisd., Spec. gén. 584: given as a MS. synonyme of Idmais (q. v.).

It has never been used, and of course falls; moreover, it is the name of one of the species upon which it was proposed to found it.

185. Calephelis.

1869. Grote-Rob., Trans. Am. Ent. Soc. ii. 310: **Cæneus** (Cænius), borealis. Type specified as Cæneus.

186. Caligo.

1816. Hübn., Verz. 51: Teucer (Teucra), Idomeneus (Idomenea), **Eurylochus** (Euriloche), Ilioneus (Ilionea).

1844. Doubl., List Br. Mus. 117: uses it for four species, allied to those of Hübner, but including none of them.

1851. Westw., Gen. Diurn. Lep. 340: employs it for Hübner's species and others, specifying Teucer and Eurylochus as the types.

1864. Herr.-Schaeff., Prodr. i. 55: uses it similarly.

1870. Boisd., Lép. Guat. 54: uses it for species placed by Westwood and Kirby in the allied genus Opsiphanes.

1871. Kirb., Syn. Cat. 127: employs it in the Westwoodian sense.

Eurylochus may be taken as type. The name is very close to Caligus (Müll., Crust. 1785). See Ærodes.

187. Calinaga.

1858. Moore, Cat. Lep. East Ind. Co. i. 162: **Buddha.** Sole species, and therefore type.

188. Calisto.

1823. Hübn., Zutr. ii. 16: **Herophile.** Sole species, and therefore type. It has been used in this sense by subsequent writers; but

1868. Butl., Ent. Monthl. Mag. iv. 194; and Cat. Sat. 97: specifies Zangis as type, of course erroneously.

189. Callerebia.

1867. Butl., Ann. Mag. Nat. Hist. [3], xx. 217: **Scanda** (Scanda, Armanda), Nirmala. Scanda is specified as type, as also subsequently (Cat. Sat.; Ent. Monthl. Mag. iv. 194).

190. Callianira.*

1816. Hübn., Verz. 38: *Astyanax* (Ephestiæna). Sole species, and therefore type.

1844. Doubl., List Br. Mus. 91: gives Eurota with a query, but this is far removed from Hübner's type.

1850. Westw., Gen. Diurn. Lep. 251: refers the generic name to Boisduval! and places in it Alcmena, Eurota, and others, with equal error.

The name is, however, preoccupied in Mollusks (Pér.-Les. 1810). See also Basilarchia.

191. Callicore.

1816. Hübn., Verz. 41: **Codomannus** (Astarte), Clymena.

1849. Doubl., Gen. Diurn. Lep. 237: Clymena and eleven others.

1861. Feld., Neues Lep. 20: cites no species, though Pandama and Bacchis are said to belong here, but erroneously [see Cyclogramma].

1869. Butl., Cat. Fabr. Lep. 64: gives Clymena (Janeira) only.

1871. Kirb., Syn. Cat. 207: also gives Clymena and a dozen other species, omitting Codomannus, which is not congeneric.

Notwithstanding the limitation of Doubleday, Butler, and Kirby, Clymena cannot be taken as type, since Billberg has earlier (Enum. Ins. 1820) selected this as the type of Diæthria (q. v.); and hence Codomannus must be the type. See also Catagramma.

192. CALLIDRYAS.

1829–30. Boisd.-LeC., Lép. Am. Sept. 73: **Eubule.** Sole species, and therefore type.
1832. Boisd. in Poey, Cent. Lép. Cuba, i.: Orbis.
1832. Ib., Voy. Astrol. 62: Pomona, Crocale (Endeer).
1836. Ib., Spec. gén. 605: gives twenty-six species, including all the above, placing them in three groups.
1870. Butl., Cist. Ent. i. 36, 46; and Lep. Exot. 155: designates Eubule as type.

193. CALLIDULA.*

1816. Hübn., Verz. 66: Evander (Evandra), Petavius (Petavia), Pyramus (Pyrame).

The first two species are not butterflies, and the genus may therefore be referred to the heterocerous Lepidoptera.

194. CALLIMORMUS.

1872. Scudd., Syst. Rev. 53: **juventus.** Sole species and designated type.

195. CALLIONA.

1868. Bates, Journ. Linn. Soc. Lond. ix. 447: **Irene,** Latona, Siaka.

Irene may be considered as the type.

196. CALLIPAREUS.

1872. Scudd., Syst. Rev. 30: **Melinus.** Sole species and designated type.

197. CALLITÆNIA.*

1861. Feld., Neues Lep. 50: no species (but an unnamed MS. one) cited.
1865. Herr.-Schaeff., Prodr. i. 82: refers Doris (Feld., Wien. Ent. Monatschr. 1860, 107) to this.

The name is, however, preoccupied by Calotænia ("Ser. Callitænia," Agass. Nomencl. Zoöl.), a genus of Lepidoptera (Steph. 1829). See Mesotænia.

198. CALLITÆRA.*

1868. Butl., Cat. Sat. 101: Menander (Menander, Andromeda), Pireta (Aurora), Andromeda (Esmeralda), Philis (Harpalyce).

This generic name falls before Cithærias (q. v.).

199. Callithea.*

1836. Boisd., Spec. gén., pl. 6 B.: Sapphira. Sole species, and therefore type.

Subsequently used by Westwood, Felder, and Kirby. The name, however, must be dropped, because based upon one of the names of the species upon which it is founded. See also Asterope.

200. Callithomia.

1862. Bates, Linn. Trans. xxiii. 522: **Alexirrhoe**, Zeuxippe, Thornax.

Alexirrhoe may be taken as the type.

201. Callizona.*

1848. Doubl., Gen. Diurn. Lep., pl. 296: *Aceste*. Sole species, and therefore type.

1850. Westw., ib. 246: Aceste (Acesta).

The name falls before Tigridia (q. v.), since that genus was restricted to Aceste by Doubleday's own action in 1844. The name is also preoccupied by Callizonus (Schönh., Col. 1826).

202. Callophrys.

1820. Billb., Enum. Ins. 80: Vulcanus, **rubi**, and a MS. species.

Rubi may be taken as type.

203. Callosune.

1847. Doubl., Gen. Diurn. Lep. 57: subfasciatus (subfasciata), Evanthe, Eucharis, Evarne, **Danæ**, Eupompe, Achine (Antevippe, Achine), Antigone, Evippe, Omphale, Thogone, Etrida, Phlegetonia, Delphine, Eione, Daira, Evagore, Ephyia (Ephya), Liagore, Eulimene, Cebrene, Ocale (Omphale, by misprint), Ione.

Wallengr. (Rhop. Caffr. 10), in founding his genus Anthopsyche, which was in general originally synonymous with this, divides it into two sections. We have above (see Anthopsyche) proposed to restrict Anthopsyche to his first section, and for his second suggest the retention of Callosune, with Danæ for type. See also Aphrodite and Anthopsyche.

204. Calornis.

1820. Billb., Enum. Ins. 77: Euterpe, Susanna, Rosalia, **Thalia**.

The first two species belong to Boisduval's Nerias (1836): Rosalia is the type of Sais (Hübner, 1816), by Doubleday's action in 1844; hence Thalia must be taken as the type of this group. See Actinote.

205. Calospila.*

1832. Gey. in Hübn., Zutr. iv. 28: *Parthaon* (Thermodoë). Sole species, and therefore type.

This name is used in the same sense by Doubleday and Westwood, and in a different sense by Bates; but the name is preoccupied by Calospilus (Hübn., Lep. 1816). See Polystichtis and Lemonias.

206. Calpodes.

1816. Hübn., Verz. 107: exclamationis (Forulus), **Ethlius.**

1870. Butl., Ent. Monthl. Mag. vii. 93: gives it as a section of Pamphila with Ethlius and others.

1872. Scudd., Syst. Rev. 61: designates Ethlius as type.

This name is written by Hübner twice as Calpodes and, including its Teutonic form, three times as Colpodes in the Verzeichniss. Colpodes would seem to be the more probably correct form, judging from the derivation of the word; but in that case it would be preoccupied, through Colpoda (Schrank, Polyg. 1803), and it would therefore be better to retain it as Calpodes.

207. Calydna.

1847. Doubl., List Br. Mus. 5: Meris, **Thersander.**

1851. Westw., Gen. Diurn. Lep. 436: employs it for Thersander and a few others.

1867. Bates, Journ. Linn. Soc. Lond. ix. 441: uses it for Thersander and many others.

1871. Kirb., Syn. Cat. 317: follows Bates.

Thersander must therefore be considered as the type.

208. Camena.*

1865. Hewits., Ill. Diurn. Lep. ii. 47: *Ctesia.* Sole species, and therefore type.

1868. Herr.-Schaeff., Prodr. iii. 21 [Camœna]: the same.

Preoccupied through Camœna (Baly, Col. 1862).

209. Candalides.

1816. Hübn., Verz. 73: **xanthospilos,** Thetys (Phædrus).

Thetys having become the type of Curetis, (the same species being given by Hübner in two genera!) xanthospilos becomes the type of this.

210. Canopus.*

1861. Wallengr. in Feld., Neues Lep. 33: *Dædalus* (Meleagris). Sole species, and therefore type.

This name is preoccupied in Hemiptera (Fabr. 1803) and Polyps (Montf. 1808). See Hamanumida.

211. CAPILA.

1865. Moore, Proc. Zoöl. Soc. Lond. 785: **Jayadeva.** Sole species, and therefore type.

This name can scarcely be considered too close to Capella, used in Mammals (Keys and Blas, 1850).

212. CAPRONA.

1857. Wallengr., Rhop. Caffr. 51: **Pillaana.** Sole species, and therefore type, as specified by Butler.

213. CAPYS.

1865. Hewits., Ill. Diurn. Lep. 58: **Alphæus.** Sole species, and therefore type. See Scoptes.

214. CARCHARODUS.*

1816. Hübn., Verz. 110: lavateræ (lavatheræ), altheæ, alceæ (malvæ).

This is subsequently used by Westwood, Stephens, and Kirby, but it falls before Urbanus. See also Spilothyrus.

215. CARIA.

1823. Hübn., Zutr. ii. 14: **Argiope** (Colubris). Sole species, and therefore type.

Used by Erichson (Schomb. Reise, 1848) in a similar sense.

216. CARTEA.

1871. Kirb., Syn. Cat. 308: **Vitula,** Tapajona.

1873. Ib., Zoöl. Rec. for 1871, 364: designates Vitula as the type.

Correctly, since it was the type of Orestias, which this name was intended to supplant.

217. CARTEROCEPHALUS.*

1852. Led., Verh. zoöl.-bot. Gesellsch. Wien, ii. 26, 49: *Palæmon* (Paniscus), Sylvius, argyrostigma.

Although proposed by Lederer to supplant Steropes, preoccupied, none of the original species of Boisduval are cited, and the short diagnosis is taken from the species above mentioned.

1867. Snell., Vlind. Nederl. 83: gives Palæmon (Paniscus) as type.

1870. Butl., Ent. Monthl. Mag. vii. 96: specifies exornatus as type, but erroneously [see Butleria].

The three species given by Felder are not congeneric with those originally specified by Boisduval under Steropes; they are mutually congeneric, however, and the name must fall before Pamphila, virtually limited in 1832 to this group.

218. CARYSTUS.

1816. Hübn., Verz. 114: **Jolus**, Hylaspes, Phyllus, Abebalus.
1869. Butl., Cat. Fabr. Lep. 273: uses it for Phyllus and three others not mentioned by Hübner.
1870. Ib., Ent. Monthl. Mag. vii. 92: specifies Jolus as type.
1871. Kirb., Syn. Cat. 589: places all of Hübner's species and others in the group.

Phyllus and Jolus being strictly congeneric, Jolus can be taken as the type.

219. CASTALIA.*

1858. Boisd. in Horsf.-Moore, Cat. Lep. East Ind. Co. i. 199: *Dichroa*, Chandra.

It is used in same sense by Felder and others. Dichroa should be type, as the only species known to Boisduval. But the genus is preoccupied, both exactly, in Worms (Savig. 1817), in Mollusks (Lam. 1819), and in Coleoptera (Lap.-Gay, 1838); and also by Castalius, a genus of Lepidoptera (Hübn. 1816).

220. CASTALIUS.

1816. Hübn., Verz. 70: Clyton, **Rosimon** (Naxus, Rosimon).
1869. Butl., Cat. Fabr. Lep. 162: uses it for Rosimon, which therefore becomes type.

221. CASTNIUS.*

1816. Hübn., Verz. 102: Iphis (Juppiter, sic!), Pelasgus, Lycagus (Lucagus).

Pelasgus is a Castnian: the others belong to the Urbicolæ; but the name is preoccupied by Castnia (Fabr., Lep. 1807), of which it was probably intended as only an altered form.

222. CASYAPA.

1871. Kirb., Syn. Cat. 576: **Corvus**, Cerinthus, Cariatus, Callixenus, Thrax, Thyrsis, Semamora, Divodasa, Chaya, Agna, Cinnara, Mangala.
1873. Ib., Zoöl. Rec. for 1871, 365: designates Corvus as type.

Correctly, since that was the type of Chætocneme, for which name this was substituted.

223. CATAGRAMMA.*

1836. Boisd., Spec. gén., pl. 5 B.: Pygas (Hydaspes). Sole species, and therefore type.

It is used in same sense by Doubleday, Felder, and Kirby; but Pygas is congeneric with Codomannus, and therefore it must fall before Callicore.

224. Catagrammina.

1867. Bates, Journ. Linn. Soc. ix. 411: **Tapaja.** Sole species, and therefore type.

225. Catargyria.

1822–26. Hübn., Exot. Schmett. ii: Druryi, **Laurentia** (Seraphina), Laure (Laura).

1861. Feld., Neues Lep. 37: uses it for Cyane, Laurentia, Laure (Laura), and Druryi.

Laurentia may be taken as the type.

226. Catasticta.

1870. Butl., Cist. Ent. i. 34, 43: **Nimbice,** Semiramis, Bithys, Sebennica. Nimbice specified as type.

227. Cathæmia.

1816. Hübn., Verz. 92: **Cæneus** (Anthyparete), Isse, Ada, Agathina (xantholeuca), Belisama, Dorimene, Hirlanda.

1867. Herr.-Schaeff., Prodr. ii. 11: uses it for Belladonna and many others, including all of the above, excepting Ada, Agathina, and Hirlanda.

Cæneus may be taken as the type.

228. Catochrysops.

1832. Boisd., Voy. Astrol. 87: Cyta, **Strabo,** Centaurus.

Strabo may be taken as the type.

229. Catonephele.

1816. Hübn., Verz. 40: **Acontius** (Eupalemæna, Chione), Numilia, Cupavia.

1849. Doubl., Gen. Diurn. Lep. 222: uses it for Numilia (Micalia), Acontius (Medea), and Chromis.

Acontius may be considered the type.

230. Catophaga.

1816. Hübn., Verz. 93: **Paulina,** Canidia (Gliciria), Cheiranthi, brassicæ, rapæ, napi (bryoniæ, napi).

Paulina may be taken as the type. See also Pieris.

231. Catopsilia.

1816. Hübn., Verz. 98: **Crocale,** Trite, Statira (Alcmeone), Pomona (Hilaria).

1871. Kirb., Syn. Cat. 481: uses for Florella and a large number of others, including all of Hübner's.

1872. Scudd., Syst. Rev. 37: designates type as Crocale.
1873. Butl., Lep. Exot. 154: makes the same designation.

232. Catuna.

1871. Kirb., Syn. Cat. 238: Crithea, **angustatum**, Opis, Cœnobita.
1873. Ib., Zöol Rec. for 1871, 360: designates angustatum as the type.

Doubtless because it was supposed * to be the type of Felder's genus Euomma (preocc.) which this supplants. See also Jæra.

233. Caudati.*

1860. Koch, Stett. Ent. Zeit. xxi. 230: Daunus and a large number of tailed Papilionids.

This group, being founded solely upon the presence of caudate appendages to the hind wings of Papilionides, would not have been excusable, scarcely tolerable, if it had been proposed in the middle of the last century; it is astonishing that it was allowed to appear in the respectable journal of Stettin; of course it must drop, even if the name were not preoccupied (Dum., Rep. 1806) or its form unobjectionable. It is also used by Swainson (Zoöl. Ill.) for a division of swallow-tails, but not in a generic sense.

234. Cecrops.*

1816. Hübn., Verz. 104: bipunctatus (Neis), **Zarex**.

Preoccupied in Crustacea (Leach, 1813).

235. Cecropterus.

1869. Herr.-Schaeff., Prodr. iii. 45: no species are cited, but it is intended to supplant the preoccupied Cecrops.
1871. Kirb., Syn. Cat. 634: gives **Zarex**, Oryx, Phrynicus, thus putting Herrich-Schaeffer's suggestion into practice.

Zarex may therefore be considered as the type.

236. Celænorrhinus.

1816. Hübn., Verz. 106: Corbulo, Niso, **Eligius**, Cebrenus, Sergestus, Lucifer, Phæomelas.

Eligius may be selected as the type. See Plesioneura.

237. Celœna.

1849. Boisd. in Doubl., Gen. Diurn. Lep. 214 [Celæna]: Doubleday gives this name as a MS. synonyme for Anartia (q. v.).

* But incorrectly; see Euomma.

1870. Boisd., Lép. Guat. 32: employs it for **Fatima.**

This is one of the species included in it by Doubleday, and therefore may be taken as the type of Boisduval's Celœna; since the species is generically distinct from Jatrophæ, the type of Anartia, the genus will stand, but date from 1870.

238. Cepora.

1820. Dalm. in Billb., Enum. Ins. 76: Monuste (Heliades MS.), brassicæ, Canidia (Gliciria), rapæ, napi, **Nerissa** (Coronnis), Daplidice, cardamines, Eupheno, Eucharis, Glaucippe, and a number of MS. species.

Nerissa may be taken as the type.

239. Ceratinia.*

1816. Hübn., Verz. 10: Eumelia, Lenea (Lenea, Melanida), *Nise* (Neso), Ninonia.

1844. Doubl., List Br. Mus. 57: uses it for Nise and Lenea (Lenea, Melanida).

1847. Ib., Gen. Diurn. Lep. 127: employs it for Nise and many others, excluding Lenea.

1862. Bates, Linn. Trans. xxiii. 523: limits it again to seven species, of which the only one of Hübner's is Ninonia, which was not used by Doubleday in the first instance, although subsequently employed by him.

1870. Boisd., Lép. Guat. 32 [Ceratonia]: employs it for a number of species, including Ninonia (Barii, Ninonia).

1871. Kirb., Syn. Cat. 21: follows Bates.

By Doubleday's restriction, however, Nise must be considered as the type. But the name is preoccupied through Ceratina (Latr., Hym. 1804).

240. Ceratrichia.

1869. Butl., Cat. Fabr. Lep. 274: **Nothus**, Phocion. Nothus designated as type.

241. Cethosia.

1807. Fabr., Ill. Mag. vi. 280: **Cydippe**, Biblis (Biblis, Penthesilea).

1809. Latr., Gen. Crust. et Ins. iv. 200: divides the group into two sections, thus: I. Juno, Julia (Alcionea); II. Cydippe, Biblis (Penthesilea); the second corresponding to the Fabrician idea.

1810. Ib., Consid. 440: designates Cydippe and Juno as types. Since Cydippe alone was mentioned by Fabricius, it becomes the type.

1820. Billb., Enum. Ins. 78: unreasonably changes the generic name to Eugramma (q. v.).

All subsequent authors have followed Latreille in the definition of the group.

1872. Crotch, Cist. Ent. i. 65: notices Cydippe as type, as above.

See Alazonia.

242. CHÆTOCNEME.*

1860. Feld., Sitzungsb. Acad. Wien. xl. 460: *Corvus*, Cerinthus.

1870. Butl., Ent. Monthl. Mag. vii. 57: indicates Corvus as the type.

The genus is preoccupied by Chætocnema (Steph., Col. 1831). See Casyapa.

243. CHÆTONEURA.*

1862. Feld., Wien. Ent. Monatschr. vi. 185: *Nearchus* (Hippulus). Sole species, and therefore type.

This name falls before Antigonus (q. v.).

244. CHALYBS.

1816. Hübn., Verz. 76: **Janias**, Telemus, Amyntor (Eryx).

1869. Butl., Cat. Fabr. Lep. 193: uses it for Janias, Telemus, and others.

Janias may be selected as the type.

245. CHAMÆLIMNAS.

1865. Feld., Reise Novara, 304: **Tircis**. Sole species, and therefore type.

Used in same sense by Bates and Kirby.

246. CHARAXES.

1816. Ochs., Schmett. Eur. iii. 18: **Jason** (Jasius). Sole species, and therefore type.

Used in this sense by subsequent authors. See Jasia and Paphia.

247. CHARIDRYAS.

1872. Scudd., Syst. Rev. 26: **Nycteis**, Carlota (Ismeria). Type specified as Nycteis.

248. Charis.

1816. Hübn., Verz. 21: Gyas (Gyadis), **Avius** (Ania).
1847. Doubl., List Br. Mus. 16: uses it for a large number of species, including Avius (Anius) of Hübner's list, which therefore becomes the type.
1851. Westw., Gen. Diurn. Lep. 452: uses it for a dozen species, including both of Hübner's.
1867. Bates, Journ. Linn. Soc. Lond. ix. 442: uses it for twenty-nine species, including Avius only of Hübner's.

249. Chilea.*

1820. Billb., Enum. Ins. 79: proposed in the stead of Libythea, for no reason whatever; of course it falls.

250. Chionobas.*

1832–33 (probably late in 1832). Boisd., Icon. 182: Aello, Norna, Jutta (Jutta, Balder), *Bootes*, Polyxenes (Bore), Œno (Œno, Also).
1833–34 (probably late in 1833). Boisd.-LeC., Lép. Amér. Sept. 214: Jutta (Balder), Bootes, Œno (Œno, Also).
1836. Boisd., Spec. gén., pl. 9 B.: Bootes.

Subsequently used by authors in same sense. But the name must fall before Œneis (q. v.).

251. Chlorippe.

1844. [Boisd. in] Doubl., List Br. Mus. 108: Laure (Laura), Laurentia, Zunilda, **Agathina.**
1850. Westw., Gen. Diurn. Lep. 302: gives it as a MS. Boisduvalian synonyme of Apatura.
1870. Boisd., Lép. Guat. 47: claims it as his own, and places in it Laure (Laura).

Boisduval's group consists of two sections, the first two species belonging to one, the last two to the other; the species of the first form the genus Catargyria, and those of the latter may be referred to this name with Agathina for type. See also Doxocopa.

252. Chlorisses.*

1832–3. Swains., Zoöl. Ill. ii. 89: *Sarpedon.* Sole species, and therefore type.

The name is preoccupied through Chlorissa (Steph., Lep. 1829). See Zetides.

253. Chlosyne.

1870. Butl., Cist. Ent. i. 38: proposes this name to take the place of Synchloe Doubl. nec Hübn.

The original species of that group were Erodyle, **Janais**, Tyrinthe (?), and Narva (Bonplandi).

Erodyle, however, was not described until 1864 by Bates (probably using a MS. name of Doubleday in the British Museum). Tyrinthe is still a MS. name, and was omitted from the "Genera," and therefore the type must be either Janais or Narva. Janais as the older name may be taken as the type.

Coatlantona (q. v.) was suggested by Kirby for the same group. It may not be amiss to remark that advance sheets of the portion of Kirby's Catalogue containing this suggestion were received by me in April, 1870, and that Chlosyne was not published until September, 1870. Kirby's Catalogue was not published, however, before the following year, and Butler was previously unaware of the intended change.

254. Choranthus.

1872. Scudd., Syst. Rev. 58: **radians.** Sole species and specified type.

255. Choridis.

1870. Boisd., Lép. Guat. 33: **Peridia.** Sole species, and therefore type.

Will this fall before Aeria?

256. Chorinea.*

1832. Gray in Griff., An. Kingd., pl. 102, fig. 1: *Licursis* (Xanthippe). Sole species, and therefore type.

But there is another species of the same restricted group which must have been known to Gray, and from which there is scarcely a doubt that he borrowed his generic name to append to his supposed new species; viz., Chorineus. The name should therefore be dropped. It is also very close to Chorinus (Leach, Crust. 1825). See also Zeonia.

257. Chroma.*

1832. Gray in Griff., An. Kingd., pl. 102, fig. 3: *basilis* (basalis). Sole species, and therefore type.

It cannot be retained, having been preoccupied by Chromis, which is used by Hübner (Lep. 1816), and Cuvier (Fishes, 1817). See also Barbicornis.

258. Chrysophanus.

1816. Hübn., Verz. 72: Phlæas (Phlæas, Timeus), Helle, Thersamon, Gordius, Hyllus, Alciphron (Hipponoe), **Hippothoe** (Chryseis, Eurybia, Hippothoe), Virgaureæ, Dorilas (Circe).

1841. Westw., Brit. Butt. 91: employs it for Phlæas, Hippothoe (Chryseis, Hippothoe), Dispar, and Virgaureæ.

1850. Steph., Cat. Brit. Lep. 17: the same.

1872. Scudd., Syst. Rev. 35: specifies Hyllus as the type, but the usage of Westwood, Stephens, and subsequent authors, will not admit of this.

Hippothoe may be taken as the type.

259. Chrysorychia.

1857. Wallengr. Rhop. Caffr. 44: **Thyra**, Perion (Tjoane).

1858. Ib., K. Vet. Akad. Förh. xv. 80: uses it for Thyra only, which must be taken as the type.

260. Cigaritis.

1847. Boisd. in Donz., Ann. Soc. Ent. Fr. [2] v. 528: **Zohra**. Sole species, and therefore type.

In speaking of this insect, Donzel says that it belongs to a group of African species, of which Boisduval "*a fait* un genre propre, sous le nom de Cigaritis;" but he does not specify them; nor can I find any mention of the genus by Boisduval himself. Zohra therefore must be considered the type.

1849. Lucas, Expl. Alg. Zoöl. iii. 362: employs it for Siphax, Zohra, and Masinissa, referring the generic name to Boisduval.

1871. Staud., Cat. Lep. Eur. 9: refers the generic name to Lucas.

261. Cinclidia.

1816. Hübn., Verz. 29: **Athalia** (Phœbe), Parthenie (Athalia), Dictynna (Orthia).

1850. Steph., Cat. Brit. Lep. 15, 259: uses it for Athalia and Parthenie.

1858. Kirb., List Brit. Rhop.: employs it for the same and another.

Athalia may be taken as type. See also Mellicta and Limnæcia.

262. Cirrochroa.

1847. Doubl., Gen. Diurn. Lep., pl. 21, fig. 2: **Aoris**. Sole species, and therefore type.

1848. Ib., ib. 157: Aoris and four others, six months later than the plates.

Used in same sense by Felder and Kirby.

263. Cissia.

1848. Doubl., List Br. Mus. App. 33: **Penelope** (Clarissa) and other species.

All but Penelope, however, bear a query. Penelope must therefore be considered as the type.

It should be noted that there is an allied species (Hesione) called Cissia by Cramer, which was known to Doubleday, having been placed by him in 1844 in Mycalesis. Also that there is a genus Cisia (Boie, Aves, 1826, written Cissa by Gray), which, however, has a distinct derivation.

264. Cithærias.

1816. Hübn., Verz. 53: Piera (Pieria), Philis (Cissa), **Andromeda**, Nereis.

1865. Herr.-Schaeff., Prodr. i. 55: uses it for Andromeda, Philis, and others not of Hübner's list.

1871. Kirb., Syn. Cat. 36: uses it for several species, including Philis and Andromeda.

Andromeda may be considered as the type. See Callitæra.

265. Cleis.*

1828–32. Guér., Voy. Coq.: *porticalis.*

It is not a butterfly. See Westw., Gen. Diurn. Lep. ii. 504.

266. Cleodis.*

1870. Boisd., Lép. Guat. 30.

No species whatever are indicated, nor any type mentioned. It is described and stated to be near Xanthocleis. It is therefore valueless until the author indicates its membership.

267. Cleosiris.*

1836. Boisd., Spec. gén., pl. 7 C.: *Catamita.* Sole species, and therefore type.

This is not a butterfly. See Westw., Gen. Diurn. Lep. ii. 504.

268. Clerome.

1849? [Boisd. in] Doubl., Gen. Diurn. Lep., pl. 54*: **Arcesilaus.** Sole species, and therefore type.

1851. Boisd. in Westw., Ib. 333: Arcesilaus, Eumeus, Faunula. Boisduval is credited with the name.

It is probable that the plates appeared before the text, but I have no proof of it; in any case, Arcesilaus may be taken as the type. See Faunis.

269. CLOTHILDA.*

1840. Blanch., Hist. Nat. Ins. iii. 440: *Pantherata* (Briaria). Sole species, and therefore type.

1848. Doubl., Gen. Diurn. Lep. 155: uses it for Pantherata and others.

Subsequently used by Felder and Kirby, but the name falls before Anelia (q. v.), Pantherata being strictly congeneric with Numida. See also Synalpe.

270. CLYTIA.*

1832–33. Swains., Zoöl. Ill. ii. 120: Clytia (Clytia, dissimilis), Macareus (Macarius), Panope, specified as types.

As the name of the group is founded upon that of one of the original species included in it, it of course falls. Even if it did not, the name is several times preoccupied, e. g. Hübner (Lep. 1816), Desvoidy (Dipt. 1830), etc.

271. COATLANTONA.

1871. Kirb., Syn. Cat. 178: Saundersii, Paupera, Mediatrix, Lacinia, Melanarge, Janais, misera, Hippodrome, Quehtala, marina, Melitæoides, Erodyle, Pœcile, **Narva**, gaudialis, Perezi, Judith.

Proposed for Synchloe Doubl. nec Hübn.; but Chlosyne had been founded a short time previously for the same purpose. See the remarks under Chlosyne. But all the species of this group cannot be placed in one restricted group, and therefore the name Coatlantona may be retained with Narva for its type.

272. COBALUS.

1816. Hübn., Verz. 115: **Virbius**, Nitocris, Adrastus, triangularis, Phorcus, Hemes, Leucomelas, and a MS. species.

1869. Butl., Cat. Fabr. Lep. 272: uses it for Virbius and other species.

1869. Herr.-Schaeff., Prodr. iii. 77: employs it for nearly eighty species, including Adrastus, triangularis (triangulum), and Phorcus.

1870. Butl., Ent. Monthl. Mag. vii. 92: employs it as a section of Carystus, and specifies Virbius as the type.

273. CŒA.

1816. Hübn., Verz. 48: Varanes (Varanessa), **Acheronta** (Acheronta, Pherecydis).

This has not been used subsequently. Varanes probably belongs to Palla (q.v.); and therefore Acheronta, which is generically distinct from Odius, may be taken as the type.

274. CŒLIADES.

1816. Hübn., Verz. 106: Forestan, **dubius**, chromus.

Dubius may be taken as the type.

275. CŒLITES.

1851. Boisd. in Westw., Gen. Diurn. Lep. 367: **Nothis**, Epiminthia.

1865. Herr.-Schaeff., Prodr. i. 62: uses it for the same.

1868. Butl., Ent. Monthl. Mag. iv. 195; and Cat. Sat. 111: designates Nothis as type.

276. CŒNONYMPHA.

1816. Hübn., Verz. 65: **Oedipus** (Œdipe), Hero, Dorus (Dorilis), Arcania, Iphis, Corinna (Corynna), Pamphilus (Lylla, Pamphile), Typhon (Philoxena), Leander (Leandra), Philea (Neoclidis).

1843. Herr.-Schaeff., Schmett. Eur. 83: uses it for all of the above.

1844. Doubl., List Br. Mus. 140: makes the same use of it.

1850. Steph., Cat. Brit. Lep. 9, 256: employs it for Typhon (Davus), Pamphilus, Hero, Arcania (Arcanius), and another.

1851. Westw., Gen. Diurn. Lep. 396: uses it for the same and others.

1858. Ramb., Cat. Syst. Lép. Andal. 23: employs it for Pamphilus and Typhon (Davus) only.

1868. Butl., Ent. Monthl. Mag. iv. 194 [Cænonympha]: designates Œdipus (Geticus) as the type.

1871. Kirb., Syn. Cat. 96: employs it for all the Hübnerian species and for others. See Chortobius (p. 293).

277. CŒNOPHLEBIA.

1862. Feld., Wien. Ent. Monatschr. vi. 422, note: **Archidona**. Sole species, and therefore type.

278. CŒNYRA.*

1865. Hewits., Trans. Ent. Soc. Lond. [3] ii. 281: *Hebe*. Sole species, and therefore type, as subsequently stated by Butler.

1871. Kirb., Syn. Cat. 93: the same.

This name, however, is preoccupied by the etymologically identical terms Cœnurus (Rud., Worms, 1809), and Cœnura (Big., Dipt. 1857).

279. COGIA.

1870. Butl., Trans. Ent. Soc. Lond. 508: **Hassan**. Sole species, and therefore type.

280. Colænis.

1816. Hübn., Verz. 32: **Julia**, Delila, Lybia, Mereaui.
1848. Doubl., Gen. Diurn. Lep. 148: divides the group into three sections, as follows: I. *a* Delila, Julia, *b* Phærusa; II. Euchroia; III. Dido.
1861. Feld., Neues Lep. 6: divides as follows: I. Phærusa; II. Julia, Delila; III. Dido.
1871. Kirb., Syn. Cat. 147: unites all in one group.
Julia may be taken as the type.

281. Colias.

1807. Fabr., Ill. Mag. vi. 284: I. Palæno, Hyale, Glaucippe; II. **rhamni**, Cleopatra.
1809. Latr., Gen. Crust. et Ins. iv. 204: uses it for rhamni, Cleopatra, and Hyale.
1810. Ib., Consid. 440: specifies rhamni as the type.
1815. Leach, Edinb. Encycl. 716: restricts the name to Hyale, but erroneously.
1815. Oken, Lehrb. i. 739: makes a similar restriction, and this has been followed by most subsequent authors, whenever they have separated the sections of Fabricius's genus as distinct genera.
1816. Hübn., Verz. 99: employs it for some approximate forms, but including none of Fabricius's.
1820–21. Swains., Zoöl. Ill. i. 5: specifies Eubule (Ebule) as type, erroneously.
1829. Curtis, Brit. Ent., pl. 242: designates Hyale as type, erroneously, as does Westwood in 1840 (Gen. Syn. 87).
1870. Butl., Cist. Ent. i. 43: designates Palæno as type, erroneously.
1872. Ib., ib. i. 66: designates rhamni as type (through Latreille, 1810).
1872. Scudd., Syst. Rev. 38: designates Palæno as type, erroneously.
See Eurymus, Earina, Gonepteryx, and Gonoptera.

282. Colobura.

1820. Billb., Enum. Ins. 79: **Dirce**. Sole species, and therefore type.
See also Gynæcia.

283. Colotis.

1816. Hübn., Verz. 97: Electra, Myrmidone, Croceus (Edusa), Aurora, Chrysotheme, **Amata** (Calais, Cypræa).

1850. Steph., Cat. Brit. Lep. 3, 252: uses it for Croceus (Edusa), Electra, Chrysotheme, and Myrmidone.

But Hyale, a species strictly congeneric with these, had already been taken as the type of Eurymus, and so this action is annulled. Amata must therefore be taken as the type. See also Zerene.

284. Comma.*

1832. Renn., Consp. 8: *c. album*. Sole species, and therefore type.

Although there is a congeneric species, called comma, it was not named until 1852, and this generic name cannot therefore be affected by it; it falls, however, before Polygonia (q. v.) See also Grapta.

285. Compsoteria.

1870. Hewits., Equat. Lep. iv. 57: **Cascella.** Sole species, and therefore type.

1872. Ib., Exot. Butt. iv.: states that this species belongs to the earlier founded genus Ithomiola, in which case this name falls, and cannot again be employed; but Kirby, in his Synonymical Catalogue, puts them far apart.

286. Conognathus.*

1862. Feld., Wien. Ent. Monatschr. vi. 181: *Platon.* Sole species, and therefore type.

But the name is preoccupied by Conognatha (Eschsch., Col. 1829).

287. Consul.

1806. Hübn., Tent.: **Hippona** (Fabius). Sole species, and therefore type.

See also Fabius, Helicodes, and Protogonius.

288. Corades.

1848. Boisd. by Doubl. in Hewits., Proc. Zoöl. Soc. Lond. xvi. 115: **Enyo.** Sole species, and therefore type, as subsequently designated by Butler.

1850. Hewits., Ann. Mag. Nat. Hist. [2] vi. 437: uses it for Enyo and others, referring the generic name to Doubleday.

289. Corbulis.*

1870. Boisd., Lép. Guat. 32: Euphon? (Euphane), Ocalea, Mahela (Neobule), Aletta, Gephira, Nise (Neso, Selene).

The name is preoccupied by Corbula (Brug., Moll. 1791).

290. Corybantes.*

1816. Hübn., Verz. 101: Amycus, Dardanus, Icarus, Licus, Syphax, Pylades.

None of these insects are butterflies.

291. Corybas.*

1870. Boisd., Lép. Guat. 43: *Tipha* (Typha). Sole species, and therefore type.

This is referred to as a MS. name of Boisduval by Westwood (Gen. Diurn. Lep. 252.—1850), where it is rightly considered as a synonyme of Pyrrhogyra (q. v.), before which it falls, Tipha having become its type in 1844.

292. Corycia.*

1822–26. Hübn., Exot. Schmett. ii.: *Appias*. Sole species, and therefore type.

This name is preoccupied by the same name given by Hübner himself (Verz. 1816) to one of the Phalænidæ!

293. Corydon.*

1869. Hewits., Ill. Diurn. Lep. pt. iv. suppl. 1: *Boisduvalii*. Sole species, and therefore type.

The name is preoccupied in Birds (Less. 1828, Wagl. 1830). See Hewitsonia.

294. Cosmosatyrus.

1867. Feld., Reise Novara, 495: **leptoneuroides**. Sole species, and therefore type, as specified by Butler.

295. Crastia.

1816. Hübn., Verz. 16: **Core**, Climena (Limnoria).

Core may be taken as the type. See Euplœa.

296. Cremna.

1847. Doubl., List Br. Mus. 14: **Actoris**, and four unpublished species. Actoris must therefore be type.

1851. Westw., Gen. Diurn. Lep. 456: Ceneus, Actoris, and two others; the characters are drawn up from Ceneus.

1867. Bates, Journ. Linn. Soc. Lond. ix. 420: uses it in the same sense.

297. Crenis.*

1821. Hübn., Index, 2: *Erato* (Brylle). Sole species, and therefore type.

1833. Boisd., Ann. Mus. Hist. 196: madagascariensis.

1847. Ib., Voy. Delegorg. ii. 592: Drusius (natalensis). These two species have nothing to do with Hübner's genus.

Doubleday, Wallengren, Butler, and Kirby have used the name in the Boisduvalian sense. The name must fall before Migonitis.

298. Cressida.*

1832–33. Swains., Zoöl. Ill. ii. 94: *Cressida* (Heliconides, Harmonides) designated as type.

The name being drawn from the species upon which it is founded, it falls. See Eurycus.

299. Cricosoma.

1865. Feld., Reise Novara, 292: **leopardinum.** Sole species, and therefore type.

Used in same sense by Bates and Kirby. Although the name is very close to Cricostoma (Klein, Moll. 1753), it differs etymologically.

300. Crocozona.

1865. Feld., Reise Novara, 296: **Pheretima.** Sole species, and therefore type.

301. Cupha.

1820. Billb., Enum. Ins. 79: **Erymanthis.** Sole species, and therefore type. See Messaras.

302. Cupido.

1801. Schrank, Fauna Boica, ii. i. 153, 206: I. Virgaureæ, Hippothoe (Hippothoe, Chryseis), Phlæas, Dorilas (Circe); II. **Arion,** Alcon, Semiargus (Acis), Damon, Cyllarus (Damœtas), Argiolus, Chiron (Eumedon), Corydon, Thetis (Adonis), Alexis, Corydon (Agestis), Argus, **Battus,** Argiades (Puer), Alsus (Puer); III. rubi, betulæ, quercus, pruni, spini.

1816. Hübn., Verz. 77: uses it for Hymen (Liger), Amor, and Chrysus. These have no generic connection with any of Schrank's species, but the last of them is closely allied to the species Cupido Linn., which may have been the cause of Hübner's selection.

1871. Kirb., Syn. Cat. 345: uses it in place of Lycæna of most modern authors, including some three hundred species, and among them all of Schrank's second section.

The name may be retained for the group represented by the first two species of the second section, with Arion for the type. [See p. 293.]

303. Curetis.

1816. Hübn., Verz. 102: **Thetys** (Æsopus), Pasiphae (Ormenus).
1871. Kirb., Syn. Cat. 418: uses it for Thetys and Bulis.

Thetys therefore becomes the type. See also Anops, Candalides, and Phædra.

304. Cyane.*

1861. Feld., Neues Lep. 22: *Leprieurii*. Sole species, and therefore type.

The name is, however, preoccupied by Cyanea (Pér. et Les., Acal. 1809).

305. Cyaniris.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 63, 94: Arion, Alcon, Cyllarus, Semiargus (Argianus), **Argiolus**, Alsus, Icarius, Thetis (Adonis), Icarus (Alexis), Alexis (Agestis), Chiron (Eumedon), Optilete, Battus, Argus.
1820. Billb., Enum. Ins. 80: uses it for all of Dalman's excepting Alcon, and for several additional species.
1872. Scudd., Syst. Rev. 34: indicates Argiolus as type. [See p. 293.]

306. Cybdelis.

1836. Boisd., Spec. gén., pl. 5 B.: **Phæsyle** (Phæsila). Sole species, and therefore type.
1844. Doubl., List Br. Mus. 89: uses it for Sydonia and others, but without including Phæsyle.
1849. Ib., Gen. Diurn. Lep. 217: uses it for three species, including Phaesyle (Phæsila).

307. Cyclogramma.

1847. Doubl., Gen. Diurn. Lep., pl. 27: **Pandama**. Sole species, and therefore type.
1848. Ib., ib. 219: the same, and a MS. species.

308. Cyclopides.

1816. Hübn., Verz. 111: Morpheus (Steropes), Palæmon (Brontes), Sylvius, **Metis**, Coras.
1850. Steph., Cat. Brit. Lep. 22, 262: uses it for Palæmon (Paniscus) and Sylvius.
1861. Staud., Cat. 15: employs it for Morpheus (Steropes).
1866. Trim., Rhop. Afr. Austr. 292: employs it for Metis and other African species.

1870. Butl., Ent. Monthl. Mag. vii. 96: indicates Morpheus (Steropes) as type, but erroneously, because Morpheus was taken by Dumeril as the type of Heteropterus in 1823. By a similar error,

1872. Scudd., Syst. Rev. 54: indicates Morpheus (Steropes) as the type.

Palæmon or Sylvius cannot be taken as the type, as would follow from Stephens's action in 1850, because Palæmon must be taken for Pamphila (q. v.): Metis may therefore be selected. See also Erynnis.

309. Cycnus.

1816. Hübn., Verz. 81: Chiton, **Phaleros** (Agis, Phaleros), Linus (Ætolus).

Phaleros may be taken as the type.

310. Cyllo.

1832. Boisd., Voy. Astrol. 140: amabilis, Constantia, **Leda.**

1844. Doubl., List Br. Mus. 120: employs it for the two latter species and others.

1851. Westw., Gen. Diurn. Lep. 360: designates Leda (Leda, Banksia) as type.

311. Cyllogenes.

1868. Butl., Ent. Monthl. Mag. iv. 194: **Suradeva.** Sole species and designated type.

312. Cyllonium.* (Fossil.)

1854. Westw., Quart. Journ. Geol. Soc. Lond. 395–6: Boisduvalianum, Hewitsonianum.

The latter is not a butterfly, and it is exceedingly doubtful if the former can be so considered. The genus is uncharacterized, but the species are figured; they are, however, so fragmentary that it would be impossible to trace any generic characters from them.

313. Cyllopsis.

1869. Feld., Verh. zoöl.-bot. Gesellsch. Wien. xix. 474: **Hedemanni.** Sole species, and therefore type.

314. Cymænes.

1872. Scudd., Syst. Rev. 61: **tripuncta,** malitiosa. Tripuncta specified as type.

315. Cymatogramma.

1849. Doubl., Gen. Diurn. Lep. pl. 49: **Echerus.** Sole species, and therefore type.

1850. Ib., in Westw. Gen. Diurn. Lep. 315: the same.

316. Cymothoe.*

1816. Hübn., Verz. 39: Cænis (Amphicede), Althea, Aconthea.
1871. Kirb., Syn. Cat. 251: employed for Cænis, Althea, and many others.

Preoccupied by Cymothoa (Fabr., Crust. 1798).

317. Cynthia.

1807. Fabr., Ill. Mag. vi. 281: I. **Arsinoe**, interrogationis; II. Œnone, Jatrophæ, cardui, Statilinus (Allionia).
1815. Oken, Lehrb. i. 737: employs it erroneously for Maturna, Cynthia, etc.
1827. Steph., Ill. Brit. Ent. Haust. 47: restricts it to cardui and Vellida (hamptsteadiensis).
1828. Horsf., Descr. Cat. Lep. E. Ind. Co., expl. pl.: cardui only.
1840. Westw., Gen. Syn. 87: specifies cardui as type.
1841. Westw., Brit. Butt. 56: uses it for cardui, Huntera, and Vellida (hamptsteadiensis).
1849. Doubl., Gen. Diurn. Lep. 212: restricts it to Arsinoe only.
1871. Kirb., Syn. Cat. 152: restricts it to Arsinoe and Erota.
1872. Crotch, Cist. Ent. i. 66: says that cardui is type, through Horsfield's action in 1828.

Cardui would be type, but that it is strictly congeneric with Atalanta which was previously (Latr. 1810) designated as type of Vanessa. Arsinoe must therefore be taken as the type.

318. Cyrenia.

1851. Westw., Gen. Diurn. Lep. 434: **Martia.** Sole species, and therefore type.

Should this name be dropped as preoccupied? Cyrene has been used in Fishes (Heck. 1840), and Hemiptera (Westw.! 1841).

319. Cyrestis.

1832. Boisd., Voy. Astrol. 117: **Thyonneus** (Thyoneus), Acilia.
1833. Ib., Ann. Mus. Hist. Nat. 190: elegans.

It has since been used in the same sense by different authors, as Doubleday, Westwood, etc.

1861. Feld., Neues Lep. 24: divides the group into two sections, to the first of which he refers Thyonneus, and to the second Risa and Rahria.

Thyonneus may then be taken as the type.

320. CYSTINEURA.*

1836. Boisd., Spec. gén., pl. 5 B.: *Dorcas* (Hersilia). Sole species, and therefore type.

Similarly used by subsequent authors. The name must fall before Mestra (q. v.).

321. DÆDALMA.

1858. Hewits., Exot. Butt. ii. 85: **Dinias**, Drusilla, Doræte, Drymæa.

1867. Butler, Ann. Mag. Nat. Hist. [3] xx. 268; Cat. Sat. 183: specifies Dinias as type.

322. DAMIS.*

1832. Boisd., Voy. Astrol. 67: Cyanea (Epicoritus), Euchylas (Coritus), Danis (Sebæ).

This name falls because founded on a specific name, Damis being one of the synonymes of Danis. See Danis and Thysonotis.

323. DAMORA.

1851. Nordm., Bull. Mosc. xxiv. ii. 439: **Sagana** (Paulina). Sole species, and therefore type.

1861. Feld., Neues Lep. 10: uses the name as a division of Argynnis.

324. DANAIDA.

1805. Latr., Sonn. Buff. xiv. 108: **Plexippus.** Sole species, and therefore type.

1830? Guér., Icon. Règne An. 474, pl. 77: Kadu (Eunica) and another.

This name is preoccupied only in botany, and ought to be restored. See Danaus.

325. DANAUS.*

1809. Latr., Gen. Crust. et Ins. iv. 201: I. *Plexippus*, similis, Midamus; II. Idea.

1810. Ib., Consid. 440: specifies Idea and Plexippus as types.

1815. Oken, Lehrb. i. 723: uses it for cratægi and allies, the Danai candidi of Linné.

1819. God., Encycl. méth. ix. 172: uses it with the spelling Danais (which has clung to it through the writings of most subsequent authors) for Latreille's first group. Consequently Plexippus is the type.

1872. Crotch, Cist. Ent. i. 60: refers it, as Oken did, to Linné and says that the type was fixed by Cuvier in 1799 (Tabl. Élém.) as brassicæ.

Linné, however, used no such word in a generic sense, but divided his genus Papilio into sections, to which he gave plural names, Danai, etc.; these again into subsections, such as Danai festivi, etc.; we must therefore disregard them altogether in treating of genera. Cuvier used it in the same plural form (Danai), but referred rapæ as well as brassicæ to it.

1872. Scudd., Syst. Rev. 7: specifies Plexippus as type.

Inasmuch as the name Danaus was proposed by Latreille to supplant his own Danaida (because preoccupied in botany, and of which Plexippus was the type), and since he subsequently specified Plexippus as one of the types in 1810, before any action had affected the Fabrician Euplœa, Plexippus would have to be considered the type of this genus, could it stand. See Danaida.

326. Danis.*

1807. Fabr., Ill. Mag. vi. 286: no species whatever indicated.

1815. Oken, Lehrb. i. 722: gives it as a division of Emesis, with no mention of species beyond the remark "vier Arten," which is copied from Fabricius.

1820. Billb., Enum. Ins. 80: changes the name for no apparent reason to Hadothera (q. v.).

1852. Westw., Gen. Diurn. Lep. 497: uses it for several species, commencing with Danis (Sebæ).

Very probably Westwood was right, as Fabricius in several instances used specific names for genera containing them. But we cannot possibly determine this fact. If it were true, the name would fall from its illegal derivation. If it were not, it would have to be dropped for want of support, or possible fixity. See Damis and Thysonotis.

327. Daptonoura.*

1869. Butl., Cat. Fabr. Lep. 209: Lycimnia, Salacia. Lycimnia specified as type.

This name falls before Melete (q. v.).

328. Darpa.

1865. Moore, Proc. Zoöl. Soc. Lond. 781: **Hanria.** Sole species, and therefore type.

329. Dasyomma.*

1860. Feld., Wien. Ent. Monatschr. iv. 401: *fuscum.* Sole species, and therefore type.

This name is preoccupied in Diptera (Mag. 1840).

330. Dasyophthalma.

1851. Westw., Gen. Diurn. Lep. 343: **Rusina**, Creusa.

Used since in same sense by Herrich-Schaeffer, Hewitson, and Kirby. Rusina may be taken as the type.

331. Debis.

1849. [Boisd. in] Doubl., Gen. Diurn. Lep. pl. 61: **Samio.** Sole species, and therefore type.

1851. Boisd. in Westw., Gen. Diurn. Lep. 358: uses it for Europa and eight others, including Samio.

Westwood designates Europa as type, but erroneously; for the plates had then been published two years, and there is no indication that Boisduval, whose statement alone would have had force, intended Europa for the type. No Boisduvalian species are placed in the genus by Westwood, and moreover Europa is the type of Lethe, so that Samio must certainly be taken as the type. If, however, Samio is generically identical with Europa, then Debis falls before Lethe (q. v.).

332. Delias.

1816. Hübn., Verz. 91: **Egialea** (Tyche, Apriate), Pasithoe (Pasithoe, Porsenna).

1870. Butl., Cist. Ent. i. 34: specifies Egialea as the type.
See Thyca.

333. Deloneura.

1868. Trim., Trans. Ent. Soc. Lond. 81: **immaculata.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 426: uses it in the same sense.

334. Dercas.

1847. Boisd. in Doubl., Gen. Diurn. Lep. 70: **Verhuellii.** Sole species, and therefore type, as subsequently indicated by Butler.

335. Desmozona.*

1836. Boisd., Spec. gén., pl. 2 B., 5 C.: Mantus (Manthus), Acherois.

1868. Bates, Journ. Linn. Soc. Lond. ix. 451: uses it for thirty-five species, including both of Boisduval's.

The name falls before Peplia. See also Heliochlæna and Nymphidium.

336. Deudorix.

1863. Hewits., Ill. Diurn. Lep. i. 16: Eryx (Amyntor), Perse, Epirus (Epirus, Despœna), Eos, Lexias, Domitia, **Epijarbas**, Diovis, Xenophon, Diœtas, Pheretima, Petosiris, Melampus, Phranga, Sphinx (Varuna), Elcia, Manea, Nissa, Orseis, Nasaka, Chozeba, Isocrates, Anta, Galathea, Timoleon, Mæcenas (Timoleon). Epijarbas is designated as the type.

Subsequently used by Herrich-Schaeffer, Butler, and Kirby. See Artipe.

337. Diadema.*

1832. Boisd., Voy. Astrol. i. 135: *Bolina* (Lasinassa), Alimena, Pandarus (Pipleis).

1833. Ib., Ann. Mus. Hist. Nat. 187: Bolina, dubius (dubia).

Bolina therefore becomes the type, and in this sense the genus is used by Doubleday, Westwood, and Felder; but the name is preoccupied in Crustacea (Schum. 1817) and Echinoderms (Gray, 1825). See Esoptria and Apatura.

338. Diæthria.

1820. Billb., Enum. Ins. 78: **Clymena.** Sole species, and therefore type. See Callicore.

339. Dicallaneura.

1867. Butl., Proc. Zoöl. Soc. Lond. 37: **pulchra**, decorata.

Pulchra may be taken as the type.

340. Dichorragia.

1868. Butl., Proc. Zoöl. Soc. Lond. 614: **Nesimachus.** Sole species and designated type.

341. Didonis.

1816. Hübn., Verz. 17: **Vitellia**, Biblis.

1844. Doubl., List Br. Mus. 144: uses it for Biblis and its allies, in which sense it has since been used by Westwood, Herrich-Schaeffer, and Kirby.

But Billberg had earlier (1820) taken Biblis as the type of Zonaga, and hence Vitellia must be used as the type.

342. Dilipa.

'1858. Moore, Cat. Lep. East Ind. Co. i. 201: **Morgiana.** Sole species, and therefore type.

343. Dione.

1816. Hübn., Verz. 31 : vanillæ, **Juno.**

Juno may be taken as the type.

344. Diophthalma.

1836. Boisd., Spec. gén., pl. 2 B., 5 C.: Sifia, **Telegone.**

Telegone may be taken as type.

345. Diorina.

1837. Boisd. in Mor., Ann. Soc. Ent. Fr. vi. 421: **Periander** (Laonome). Sole species, and therefore type.

Since used in same sense; but frequently (as by Doubleday, Bates, and Kirby), with the incorrect spelling Diorhina. See also Rodinia and Rhetus.

346. Dipsas.*

1847. Doubl., List Br. Mus. 25: Ataxus, *Syla* (Pholus), (both inedited).

1852. Westw., Gen. Diurn. Lep. 479: Syla (Sila), Ataxus, and ten others. Syla specified as type.

1865. Hewits., Ill. Diurn. Lep. 64: also specifies Syla and Ataxus as types.

The genus is however preoccupied in Reptiles (Lam. 1768) and Mollusks (Leach, 1814).

347. Dira.

1816. Hübn., Verz. 60: Roxelana (Roxelane), Megæra, Mæra, **Clytus** (Clyte).

1850. Steph., Cat. Brit. Lep. 6: uses it for Megæra.

Clytus must be taken as the type, as the other species fall into Lasiommata and Pararge. See also Amecera, Leptoneura, and Maniola.

348. Dircenna.

1847 (Aug.). Doubl., Gen. Diurn. Lep. pl. 17: **Jemima** (Iambe). Sole species, and therefore type.

1847 (Nov.). Ib., ib. 119: Jemima (Iambe), and other MS. or queried names.

1862. Bates, Linn. Trans. xxiii. 520: employs it for eight species, including the above.

1871. Kirb., Syn. Cat. 20: follows Bates.

349. ... DYSA...

1836. Boisd., Spec. gén., pl. 4 ... (... Mylitta). Sole species,

In the explanation of th... Pl. 4 A. it is spelled Disc... Doubleday, Westwood, a... Kirby, but preoccupied by Dynamena (Lam., The name is very close ...

35... DYSA...

1816. Hübn., Verz. 10: L... Napoleon. Sole species,

1870. Butl., Cist. Ent. 39. ... Diurn. Lep. 346: Napoleon (Napoleo),

1861. Hewits., Exot. Bu. ...

Used in same sen... of the text, Napoleon must be the type. be taken as the type.

... DYS...THEA.

1861. Feld., Neues Le... Phil. v. 222: Lycaste, Salapia, Terra, species, an... as the type.

... DYS...

1832. Gray, Griff., An... Albicilla cruentus. Albicilla specified and there...

Preoccupied ... with Palemon, the necessary type of owes its origin ... Syrmatia.

... DYS...

1807. Fabr., Ill. Ma...

1815. Leach, Edin... Lond. ix. 382: Portia, costalis. Apollo... genus ... generi...

1816. Dalm., Vet... Lep. 19: Sabadius. Sole species, type.

1816. Hübn., Ver... incorr...

1832. Dup., Pap. ... Thraso. Sole species, and there- Apoll... by ... genu...

1840. Westw., ...

1872. Crotch, ... Fabricius (Wesm., Hym. 1837). See Hü...

See Ar...

355. Doxocopa.

1816. Hübn., Verz. 49: Erminea, Iris, Ilia (Ilia, Astasia), Agathina, **Polyxena** (Epilais).

1865. Herr.-Schaeff., Prodr. i. 80: uses it for Idyia, Celtis, Argus, none of them Hübner's species, although congeneric with Agathina.

1872. Scudd., Syst. Rev. 9: in accordance with Herrich-Schaeffer's use of the name, specifies Agathina as type.

But it cannot so be considered, since Agathina must be referred to Chloripppe (q. v.). Erminea has been taken as the type of Apaturina, Iris and Ilia belong to Potamis, and hence this group must be restricted to Polyxena and its allies.

356. Drucina.

1872. Butl., Cist. Ent. i. 72: **Leonata** specified as type.

357. Drusilla.*

1820–21. Swains., Zoöl. Ill. i. i. 11: *Urania* (Jairus), Horsfieldii. Urania (Jairus) specified as type.

Used in same sense by Westwood: but the name falls before Tænaris, and is preoccupied in Coleoptera (Leach, 1819).

358. Dryas.

1806. Hübn., Tent. 1: **Paphia.** Sole species, and therefore type.

1847. Boisd., Voy. Deleg. ii. 588: uses it for Leda, which has nothing to do with the Hübnerian genus, but belongs to a distinct family.

1865. Feld., Reise Novara, 305: uses it for Cinaron, which has nothing to do with either the Hübnerian or the Boisduvalian genus! See Aculhua.

Wallengren has followed Boisduval; Bates has followed Felder; and Herrich-Schaeffer, in his Prodromus, has followed both the one and the other! See Argynnis.

359. D'Urbania.

1862. Trim., Trans. Ent. Soc. Lond. [3] i. 400: **Amakosa.** Sole species, and therefore type.

360. Dyctis.

1832. Boisd., Voy. Astrol. 138: **Agondas.** Sole species, and therefore type.

1851. Westw., Gen. Diurn. Lep. 353: the same.

1869. Butl., Cat. Fabr. Lep. 38: employs it for Vitellia, undularis, Panthera, and Lais.

1871. Kirb., Syn. Cat. 112: uses it in the same sense.

Lais may be taken as the type.

375. Emesis.

1807. Fabr., Ill. Mag. vi. 287: **Fatima** (Ovidius), Absolon (Absalon).

1815. Oken, Lehrb. i. 722: enlarges it greatly, making it include many other of the Fabrician genera, but in Emesis proper places the Fabrician species and others.

1816. Hübn., Verz. 21: refers four species to it allied to Fatima, but places that in his Polystichtis. See Mesene.

1820. Billb., Enum. Ins. 81: changes the name, for no apparent reason, to Tapina.

1818. Hoffm., Wied. Zoöl. Mag. i. ii. 98: employs it for Fatima (Ovidius), and many others, not including Absolon, so that Fatima becomes the type.

1840. Blanch.-Brullé, Hist. Nat. Ins. iii. 466: specify Crœsus as type, of course erroneously.

1847. Doubl., List Br. Mus. 9: employs it for Lucinda, Mandana, (Arminius), and Fatima, besides some MS. species.

1851. Westw., Gen. Diurn. Lep. 421, 446: specifies Fatima (Ovidius) as type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 436: employs it for Lucinda and others, including neither of the species of Fabricius.

1871. Kirb., Syn. Cat. 312: follows Bates in general, but includes Fatima.

1872. Crotch, Cist. Ent. i. 66: says Fatima (Ovidius) is type through Westwood in 1850. See Nelone.

376. Enantia.

1816. Hübn., Verz. 96: Melite, **Licinia** (Lininia).

Licinia may be taken as the type. See Licinia.

377. Endopogon.

1864. Boisd. in Feld., Spec. Lep. 4: **Sesostris** (Sesostris, Zestos, Tarquinius), Childrenæ, Vertumnus (Vertumnus, Cutora, Iphidamas, Erithalion, Zeuxis, Alyattes, Rhamases), Anchises, Telmosis, Erlaces, Phosphorus, Cyphotes (Hierocles, Eteocles, Lycomes), Nephalion, Idalion,

Polyzelus, **Arcas** (Xenares, Arcas), Toxaris (Toxaris, Anacharsis), Cymochles (Cymochles, Orbignyanus), Serapis (Serapis, Osyris), Pomares.

Sesostris may be taken as the type.

378. Endymion.*

1832–33. Swains, Zoöl. Ill. ii. 85: *regalis*. Sole species, and therefore type.

But Endymion is one of the synonymes of regalis, so that this name must be dropped. See Eucharia, Evenus, and Arcas.

379. Enispe.

1848. Doubl., Gen. Diurn. Lep., pl. 40: **Enthymius**. Sole species, and therefore type.

1850. Ib. in Westw., Gen. Diurn. Lep. 292: the same.

380. Enodia.

1816. Hübn., Verz. 61; **Portlandia** (Andromacha), Dejanira, Hyperanthus (Hyperanthe).

1844. Doubl., List Br. Mus. 136: uses it for Alope and Hyperanthus.

In this sense the genus is used by Westwood, Stephens, and Kirby (List), but Hyperanthus was virtually the type of Hipparchia in 1820.

1872.* Scudd., Syst. Rev. 5: designates Portlandia as the type.

381. Enope.*

1858. Moore, Cat. Lep. E. Ind. Co. i. 228: Pulaha, Bhadra.

According to Kirby (in litt.) this name is preoccupied in Lepidoptera (Walk. 1854). See Neope.

382. Entheus.

1816. Hübn., Verz. 114: **Peleus**. Sole species, and therefore type.

1871. Kirb., Syn. Cat. 579: uses it for more than twenty species, including Peleus. See Phareas and Peleus.

383. Epargyreus.

1816. Hübn., Verz. 105: Prodicus, **Tityrus** (Clarus), Pomus (Comus), Evadnes, Epitus, Brino, Orchamus.

1869. Butl., Cat. Fabr. Lep. 275: uses it for Mathias and others, none of which are mentioned by Hübner.

1872. Scudd., Syst. Rev. 49: specifies Tityrus as type.

384. Ephyriades.

1816. Hübn., Verz. 111: **Otreus**, Folus, Tryxus, Asychis.

Otreus may be taken as the type.

385. Epicalia.*

1844. [Boisd. in] Doubl., List Br. Mus. 90: Acontius (Antiochus), Numilia (Numilius), Obrinus (Ancæa).

1850. Boisd. in Westw., Gen. Diurn. Lep. 256: uses it in same sense.

1861. Feld., Neues Lep. 17: I. Acontius; II. species not mentioned by Doubleday; III. Obrinus (Ancæa), and another.

1870. Boisd., Lép. Guat. 40: claims it as his own, and refers to it Nyctimus, Antinoe, and Numilia.

The name is preoccupied through Epicallia, used in Lepidoptera (Hübn. 1816), and Epicalla, used in Coleoptera (Dej. 1833). All have the same derivation.

386. Epigea.*

1816. Hübn., Verz. 62: Euryale (Adyte, Euryale), Ligea, Embla, Medea, Pyrrha.

1850. Steph., Cat. Brit. Lep. 8: uses it for Ligea and Medea (Blandina).

But the name falls before Erebia. See also Gorgo, Marica, Syngea, Phorcis, and Oreina.

387. Epinephele.*

1816. Hübn., Verz. 59: *Jurtina* (Janira), Lycaon (Eudora), Clymene (Synclimene).

1843. Herr.-Schaeff., Schmett. Eur. i. 81: uses it for the first two of these and for others.

1850. Steph., Cat. Brit. Lep. 7 [Epinephila]: uses it for Jurtina (Janira).

1858. Kirb., List Brit. Rhop.: the same.

1868. Butl., Ent. Monthl. Mag. iv. 194; and Cat. Sat. 64: designates Jurtina (Janira) as type.

The name, however, is preoccupied by Epinephelus (Bloch-Schneid., Fishes, 1801).

388. Epinetes.*

1820. Billb., Enum. Ins. 77: Ceres (Sebethis MS.), Isabella, Calliope, Polymnia, Psidii, diaphanus, and some MS. species.

A heterogeneous group which would best be left unused.

389. EPIPHILE.

1844. [Boisd. in] Doubl., List Br. Mus. 90: **Orea**, Laothoe (Merione, Liberia).
1849. Boisd. in Doubl., Gen. Diurn. Lep. 224: Orea, Chrysites, Lampethusa, ? Laothoe.
1870. Boisd., Lép. Guat. 40: Ariadne, Chrysites, Epicaste, Adrasta.
1871. Kirb., Syn. Cat. 201: employs it for all the above, excepting Laothoe and Ariadne, and for others.

Orea may therefore be taken as the type.

390. EPITOLA.

1852. Boisd. in Westw., Gen. Diurn. Lep. 470: **Elion**. Sole species, and therefore type.

391. EREBIA.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 58, 79: I. Ægeria (Egeria), Mæra, Megæra; II. Semele, Agave (Hippolyte), Norna, Polyxenes (Bore), Hyperanthus, Medusa, **Ligea**, Manto, Embla, Jurtina (Janira), Typhon (Davus), Pamphilus, Hero, Arcania, Iphis. Ligea is specified as type.
1832–3. Boisd., Icones, 147: uses it for Pronoe (Neorides) and others, including a mention of Ligea.
1843. Herr.-Schaeff., Schmett. Eur. 55: refers to it a large number of species, including Ligea.
1844. Doubl., List Br. Mus. 123: employs it for a large number, including Ligea.
1850. Westw., Gen. Diurn. Lep. 376: makes similar use of it.
1868. Butl., Ent. Monthl. Mag. iv. 194; and Cat. Sat. 72: specifies Ligea as type.

See Gorgo, Marica, Syngea, Phorcis, Epigea, Oreina, and Maniola.

392. ERESIA.

1836. Boisd., Spec. gén., pl. 7 B.: **Eunice** (Eunica). Sole species, and therefore type.
1844. Doubl., List Br. Mus. 64: uses it in this sense.
1848. Ib., Gen. Diurn. Lep. 182: the same extended.
1861. Feld., Neues Lep. 10 and App.: refers to it Nycteis, Ismeria, and others.

The name is very near to Eresus (Walck. Arachn. 1805).

393. Ergolis.

1836. Boisd., Spec. gén. pl. 4 A: **Ariadne** (larva and pupa only figured). Sole species, and therefore type.

Used in same sense by Doubleday, Westwood, and Kirby. See Ariadne.

394. Eribœa.

1816. Hübn., Verz. 46: Brutus (Bruta), Jason (Unedonis), Pelias (Pelopia), Lucretia, Castor (Castoris), Pollux (Pollussa), Æclus (Aile), Tiridates (Tiridatis), Athamas (Athamis), **Etheocles** (Etheoclessa), Xiphares (Thyestessa, Xypharis), Pyrrhus (Pyrrichia), Euryalus (Euriale).

Is this name too near Erebia (Dalm., Lep. 1816) to be used? If not, Etheocles may be considered the type.

395. Erina.*

1832–33. Swains., Zoöl. Ill. ii. 134: Xanthospilos (pulchella), Erinus, ignita. Erinus specified as typical.

The generic name, being based upon it, must drop. See Holochila and Polycyma.

396. Erites.

1851. Boisd. in Westw., Gen. Diurn. Lep. 392: **Medura** (Madura). Sole species, and therefore type, as stated by Butler.

397. Eroessa.

1847. Doubl., Gen. Diurn. Lep. 56: **chilensis**. Sole species, and therefore type, as stated by Butler.

398. Eronia.

1822–26. Hübn., Exot. Schmett. ii.: **Cleodora**. Sole species, and therefore type, as specified by Butler.

1836. Boisd., Spec. gén. 604: the same.

The genus has been used in the same sense by authors.

399. Erora.

1872. Scudd., Syst. Rev. 32: **læta**. Sole species and designated type.

400. Erotion.*

1820. Dalm. in Billb., Enum. Ins. 80. *Cupido*. Sole species, and therefore type.

The name falls before Helicopis. See also Hexuopteris.

401. Erycides.

1816. Hübn., Verz. 110: **Pygmalion** (Pigmalion), Gnetus (Megalesius).

1852. Westw., Gen. Diurn. Lep. 509: uses it for seven species, including Pygmalion.

1869. Butl., Cat. Fabr. Lep. 266: employs it for Palemon only, not specified by Hübner.

1869. Herr.-Schaeff., Prodr. iii. 59: refers a great many species to it, including Pygmalion and Palemon.

1870. Butl., Ent. Monthl. Mag. vii. 92: employs it not only for Palemon, but for many others, including Pigmalion.

1871. Kirb., Syn. Cat. 587: places Pygmalion in it, with nearly thirty others.

1872. Scudd., Syst. Rev. 46: specifies Pygmalion (Pigmalion) as the type.

402. Erycina.*

1807. Fabr., Ill. Mag. vi. 286: *Melibœus*, Lysippus, Orsilochus.

1809. Latr., Gen. Crust. et Ins. iv. 205: extends the group, including in it all of the above.

1810. Ib., Consid. 440: Lamis, Fatima, Melander, Lysippus, and Melibœus are specified as types. One of the last two of these must therefore be chosen.

1815. Oken, Lehrb. i. 722: gives it as a section of Emesis, referring to it the Fabrician species.

1816. Hübn., Verz. 22: restricts it to Thisbe (perdita), and Lysippus (Lysippe).

The latter, therefore, is type, as stated by Crotch (Cist. Ent. 1872). Most authors have considered Melibœus as typical, as would have been the case but for Hübner, Hoffman (Wied. Zöol. Mag. I. ii. 97) specifying only Melibœus of the species given by Fabricius. But the genus is preoccupied in Mollusks (Lam. 1805). See Riodina and Ancyluris.

403. Erynnis.

1801. Schrank, Faun. Boica. ii. i. 157: alceæ (malvæ), malvæ (Fritillum), Tages, comma, Thaumas (linea), Morpheus (Speculum).

1820. Oken, Naturg. f. Schulen, 788: alceæ (Malvarum).

1858. Ramb., Cat. Lép. Andal. 83:* Tages (Cervantes), Marloyi.

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* Rambur also in another work (Faune Ent. Andal.) restricts Erynnis to Tages (Cervantes). The portion of the work containing this (p. 310) may have been printed as early as 1840, but does not appear to have been issued before 1870, judging from the memoranda attached to the copy in the Library of the Entomological Society of France. See also Staudinger's Catalogue, 1871, p. xxx.

1861. Staud., Cat. Lep. Eur. 15: uses it for several species, including Tages.

1871. Kirb., Syn. Cat. 610: employs it for alceæ and others not of Schrank's list. See also Journ. Linn. Soc. Zoöl. x. 498.

1872. Scudd., Syst. Rev. 50: specifies Tages as type.

Neither alceæ nor Tages can, however, be taken as type, for both were previously eliminated (see Urbanus and Thanaos); malvæ was already type of Hesperia in 1798, Thaumas of Adopæa in 1820, and Morpheus of Heteropterus in 1832; there is nothing left but comma, which virtually became the type of the genus in 1832. This necessitates further changes in Pamphila and Cyclopides. See Augiades.

404. Eryphanis.

1870. Boisd., Lép. Guat. 57: **Automedon.** Sole species, and therefore type. Also spelled by Boisduval Euryphanis and Eryphane.

Used by Kirby in same sense.

405. Erythia.

1818. Hübn., Verz. 24: **Labdacus** (Labdaca), Gelanor (Gelanoria), Melaphæa, Teleclus (Cataleuce).

Labdacus may be taken as the type.

406. Esoptria.*

1816. Hübn., Verz. 45: *Bolina* (Alcithoe, Bolina). Sole species, and therefore type.

But this name falls before Apatura, through Hübner's own writings. See also Diadema.

407. Esthemopsis.

1865. Feld., Reise Novara, 306: **Clonia.** Sole species, and therefore type. See Pseudopheles.

408. Eteona.*

1848. [Boisd. in] Doubl. List Br. Mus. App. 21: *Tisiphone.* Sole species, and therefore type.

1848. [Ib. in] Westw., Gen. Diurn. Lep., pl. 42: the same.

1850. Ib. in Westw., Gen. Diurn. Lep. 254: the same.

The name is preoccupied by Eteone (Sav., Worms, 1817).

409. Eubagis.

1832. Boisd., Voy. Astrol. 70: **Athemon** (Arthemon). Sole species, and therefore type.

Used in the same sense by Doubleday and Felder.

410. Eucharia.*

1870. Boisd., Lép. Guat. 14: Ganymedes, imperialis, regalis.

The name is preoccupied in Lepidoptera (Hübn., 1816) and in Arachnids (Koch, 1835). See also Evenus, Arcas, and Endymion.

411. Eucheira.*

1834. Westw., Trans. Ent. Soc. Lond. i. 44: *socialis*. Sole species, and therefore type, as indicated by Butler.

The name is preoccupied by Eucheirus (Dej., Col. 1833).

412. Euchloe.

1816. Hübn., Verz. 94: Ausonia (Belia, Ausonia), Tagis, Genutia (Midea), **cardamines**, Eupheno, Eucharis (Cœneos).

1841. Westw., Brit. Butt. 30: employs it for cardamines only, and therefore this must be taken as the type. Stephens (1850) and Kirby (1858) make the same use of it.

1872. Scudd., Syst. Rev. 42: specifies Genutia (Midea) as the type, but erroneously. See also Kirby, Zoöl. Rec. 1872, 339. See Anthocharis.

413. Eudæmon.*

1820. Dalm. in Billb., Enum. Ins. 76: Midamus (Midamus, Claudius, Mulciber), similis, Panope, Clytia (dissimilis), assimilis, Plexippus (Plexippus, Hegesippus), Erippus, Chrysippus (Chrysippus, Alcippus).

The name is preoccupied by Eudæmonia (Hübn., Lep. 1816).

414. Eudamus.

1832–33. Swains., Ill. ii. 48: Chalco (Agesilaus), Brachius (Doryssus), **Proteus**. Proteus designated as type.

1833–34. Boisd.-LeC., Lép. Am. Sept., pl. 69: use it for Proteus and many others.

1869. Butl., Cat. Fabr. Lep. 260: uses it, but places Proteus elsewhere.

1870. Ib., Ent. Monthl. Mag. vii. 56: employs it for others than Proteus, and places Proteus elsewhere. See Goniurus.

415. Eueides.

1816. Hübn., Verz. 11: **Dianasa**, Halia, Pasinuntia, Eucoma, Mneme, Numata (Pione), Harmonia.

1844. Doubl., List Br. Mus. 57: uses it for Dianasa and an unnamed species.

1848. Ib., Gen. Diurn. Lep. 145: divides the group into two sections, the second containing Dianasa.

1861. Feld., Neues Lep. 6: makes a similar division and reference.

1862. Bates, Linn. Trans. xxiii. 562: uses it for eight species, none of them the originals of Hübner.

Dianasa must be considered as the type.

416. Euerycina.

1849. Saund., Trans. Ent. Soc. Lond. [2] v. 97: **Calphurnia.** Sole species, and therefore type.

Thus used by Bates and Kirby. See Rodinia.

417. Euglyphus.*

1820. Dalm. in Billb., Enum. Ins. 80: *Chiron.*

The name is preoccupied by Euglyphis (Hübn., Lep. 1816). See Marius and Megalura.

418. Eugonia.

1816. Hübn., Verz. 36: c. aureum (Angelica), Polynice, vau. album (v. album), **Polychloros** (Polychloros, Pyrrhomelæna), urticæ, Charonia, Antiopa.

1850. Steph., Cat. Brit. Lep. 12: uses it for Antiopa, Polychloros, and urticæ.

1873. Grote, Can. Ent. v. 144: says that c. aureum (Angelica) is the type; but, owing to the limitation of Stephens, that is impossible.

Polychloros may be taken as the type.

419. Eugraphis.*

1820. Dalm. in Billb., Enum. Ins. 75: *Polyxena* (Hypsipyle). Sole species, and therefore type.

Preoccupied through Eugraphe (Hübn., Lep. 1816). See Thais and Zerynthia.

420. Eulaceura.

1871. Butl., Proc. Zoöl. Soc. Lond. 726: **Osteria.** Sole species and designated type.

421. Eulepis.

1820. Dalm. in Billb., Enum. Ins. 80: **Athamas.** Sole species, and therefore type.

422. Eumæus.

1816. Hübn., Verz. 67: **Minyas.** Sole species, and therefore type.

Subsequently used by various authors in the same sense.

1837–47. Gey. in Hübn., Exot. Schmett. [Eumæa] iii.: uses it for Debora.

See also Eumenia.

423. Eumenia.*

1823. God., Encycl. méth. 826: *Minyas* (Toxea). Sole species, and therefore type.

1836. Boisd., Spec. gén. 5 C.: the same species.

But the name must fall before Eumæus (q. v.). Godart must have borrowed from Hübner in this case, as Eumæus must have been published by 1818, and two such similar names could not have been proposed independently for the same insect.

424. Eumenis.

1816. Hübn., Verz. 58: Antonoe, Aello, **Semele**, Celimene (Tarpeja).

1850. Steph., Cat. Brit. Lep. 7: uses it for Semele, which therefore becomes the type.

1858. Kirb., List Brit. Rhop.: employs it for Semele and Briseis.

425. Eumesia.*

1867. Feld., Reise Novara, 504: *semiargentea*. Sole species, and therefore type, as stated by Butler.

But the name is preoccupied, through Eumesius (Westw., Hym. 1840).

426. Eunica.

1816. Hübn., Verz. 61: Anna, **Monima**.

1849. Doubl., Gen. Diurn. Lep. 222: employs it for a number of species, including both of Hübner's.

Used in a similar sense by Felder, Butler, and Kirby. Monima may be taken as the type.

427. Eunogyra.

1851. Westw., Gen. Diurn. Lep. 463: **Satyrus**. Sole species, and therefore type.

Used in same sense by Bates and Kirby.

428. Euomma.*

1867. Feld., Reise Novara, 425: angustatum. Sole species mentioned.

The name is proposed, however, to take the place of Jæra (q. v.) preoccupied, with two species of which, Opis and Crithea, angustatum is congeneric; and therefore one of these two must be taken as the type. But Euomma is itself preoccupied, as Mr. Kirby has pointed out to me, in Coleoptera (Boh. 1858). See Catuna.

429. Eupalamides.*

1816. Hübn., Verz. 101: *Dædalus*. Sole species, and therefore type.

It is not a butterfly.

430. Euphædra.

1816. Hübn., Verz. 39: Themis, **Cyparissa**, Ceres.

1871. Kirb., Syn. Cat. 247: uses it for the same and many others.

Cyparissa may be taken as the type.

431. Euphœades.

1816. Hübn., Verz. 83: Glaucus, **Troilus**, Palamedes (Chalcas), Polyxenes (Asterius).

1872. Scudd., Syst. Rev. 44: specifies Glaucus as type.

Glaucus, however, cannot be taken as type, being the necessary type of Jasoniades. Troilus may therefore be chosen. See Pterourus.

432. Euphydryas.

1872. Scudd., Syst. Rev. 27: **Phaeton**. Sole species and designated type.

433. Euphyes.

1872. Scudd., Syst. Rev. 69: **Metacomet**, vestris, singularis, Osyka, verna. Metacomet specified as type.

434. Euplœa.

1807. Fabr., Ill. Mag. vi. 280: Plexippus, **similis**, Core (Corus).

1816. Ochs., Schmett. Eur. iv. 15: uses it for Chrysippus.

1816. Hübn., Verz. 15: employs it for a number of forms, including only Plexippus of the Fabrician species.

But Plexippus is the type of Danaida, so that this cannot stand. Core would have to be taken as the type (for it is in this sense that it has been used by subsequent authors, such as Boisduval, who invariably spells it Euplæa, Doubleday, Herrich-Schaeffer, and Kirby), were it not that previous to these writers Hübner, in 1816, had taken Core and a close ally to form his Crastia (q. v.); hence similis, which is generically distinct from Plexippus, must be taken as the type.

1872. Crotch, Cist. Ent. i. 66: says that Leucostictos (Eunice) is the type, through Boisduval in 1832; but it is not one of the species mentioned by Fabricius.

435. Euptoieta.

1848. Doubl., Gen. Diurn. Lep. 168: Hegesia, **Claudia**.

Used in same sense by Felder and Kirby.

1872. Scudd., Syst. Rev. 22: specifies Claudia as the type.

436. EUPTYCHIA.

1816. Hübn., Verz. 54: **Herse**, Penelope (Clarissa), Hesione (Ocyrrhoe), Ocypete, Cephus (Lisidice), Hermes (Hermessa), Mollina (Molina), Lydia, Junia, Libye, Tolumnia, Chloris (Chlorimene), Arnæa (Ebusa), Myncea, and a MS. species.

1844. Doubl., List Br. Mus. 122: uses it for four species, of which three are Hübner's; viz., Hesione (Cissia), Arnæa (Ebusa), and Tolumnia.

1851. Westw., Gen. Diurn. Lep. 372: employs it for the same and others, including Herse.

1868. Butl., Ent. Monthl. Mag. iv. 194: specifies Herse as type.

1871. Kirb., Syn. Cat. 47: uses it for all of Hübner's species and others.

As Herse appears to be strictly congeneric with Tolumnia, it can be accepted as the type.

437. EURALIA.

1850. Westw., Gen. Diurn. Lep. 281: **dubius** (dubia), Anthedon.

1861. Feld., Neues Lep. 25 [Eucalia]: the same.

Dubius may be considered the type.

438. EUREMA.

1816. Hübn., Verz. 96: **Delia** (Demoditas), Elathea, Sylvia (Eudoxia), Agave (Jodutta, Phiale), albula (Nise), Hecabe.

1844. [Boisd. in] Doubl., List Br. Mus. 83: uses it for Lethe and Zabulina, which have nothing to do with Hübner's genus. See Hypanartia.

1848. Boisd. in Doubl., Gen. Diurn. Lep. 176: makes the same general use of it.

1850. Steph., Cat. Brit. Lep. 252: employs it for Philodice and Palæno (Palæno, Europome), which is nearer the Hübnerian mark, but still erroneous.

1861. Feld., Neues Lep. 12: uses it in Doubleday's sense.

1870. Boisd., Lép. Guat. 39: does the same.

1870. Butl., Cist. Ent. i. 35: designates the type as Delia.

1872. Scudd., Syst. Rev. 39: the same.

Should it be written Heurema?

439. EURHINIA.

1867. Feld., Reise Novara, 405: Polynice (Elpinice, Megalonice, Stratonice). Sole species; the name Eurhinia, however,

is evidently given to supplant Rhinopalpa (q. v.) preoccupied, of which **fulva** was the type.

Fulva, therefore, and not Polynice, must be taken as the type of Eurhinia. This name, however, is certainly very close to Eurhina (Fitz., Rep. 1843) and Eurhinus (Kirb., Col. 1817).

440. EURIPHENE.

1847. Boisd., Voy. Deleg. ii. 592: **cærulea**. Sole species, and therefore type.

Used in same sense (but spelled Euryphene) by Westwood, Felder, and Kirby.

441. EURIPUS.

1848. Doubl., Gen. Diurn. Lep., pl. 41: **Halitherses.** Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 293: Halitherses, consimilis (Hallirothrius).

1861. Feld., Neues Lep. 26: uses it in the same sense.

The name is rather near to Eurrhypis (Hübn., Lep. 1816).

442. EURYADES.

1864. Feld., Spec. Ins. 39: Duponchelii, **Corethrus.**

Used with exactly the same limitation by Herrich-Schaeffer and Kirby. Inasmuch as the Felders remark that they had not seen the first species, Corethrus may be taken as the type.

443. EURYBIA.

{1816. Hübn., Verz. 17: **Nicæus** (Nicæa), Halimede, Dardus (Upis).
{1818. Ill., Wied. Zoöl. Mag. i. ii. 100: Nicæus, Halimede, Lamia.

With the exception of the last species in each case, the usage of Hübner and Illiger is identical. Recalling the statements made in the introduction to this essay, there can be no question that this name should be credited to Illiger.

1819. God., Encycl. méth. 459: uses it for Carolina, Nicæus, and Dardus.

1832. Guér., Iconogr., pl. 80, fig. 4 [Erybia]: carolina.

Whether Illiger or Hübner have priority, Nicæus, by Godart's usage, must become the type.

444. EURYCUS.

1836. Boisd., Spec. gén. 391: **Cressida** (Cressida, Harmonia). Sole species, and therefore type.

In this sense it has been used by all subsequent authors. See Cressida.

445. Eurygona.

1836. Boisd., Spec. gén., pl. 3, 5 C.: Crotopus (Midas). [larva and pupa only], **Phaedica.**

1847. Doubl., List Br. Mus. 5: employs it for several species, but for neither of the above.

1851. Westw., Gen. Diurn. Lep. 437: employs it for many species, including both of Boisduval's and some of Doubleday's.

1867. Bates, Journ. Linn. Soc. Lond. ix. 420: employs it for more than sixty species, including both of Boisduval's.

Phædica may be taken as the type.

446. Eurymus.

1829. Swains. in Horsf., Descr. Cat. Lep. E. Ind. Mus. 129, 134: **Hyale.** Sole species given, and designated type. Said by Horsfield to have been so given him by Swainson about eight years previously.

1832–33. Swains., Zoöl. Ill. ii. 60, 70: Philodice (Philodice, Europome). See Colias.

447. Eurytela.

1833. Boisd., Ann. Mus. Hist. Nat. 202: Horsfieldii (Horsfieldii, Stephensii), **Dryope.**

1844. Doubl., List Br. Mus. 145: uses it for Dryope and two others.

Dryope is therefore the type.

448. Eurytides.

1822–26. Hübn., Exot. Schmett. ii.: **Dolicaon,** Iphitas.

Dolicaon may be taken as the type.

449. Euschemon.*

1846. Doubl. in Stoke's Austr. i. App. 513: *Rafflesia.* Sole species, and therefore type.

Preoccupied, through Euschema (Hübn., Lep. 1816).

450. Euselasia.

1816. Hübn., Verz. 24: Crotopus (Crotope), Hygenius (Hygenia), Orfita (Orsita), Arbas (Arbassa), Sabinus (Tenage), Euriteus (Cynira*), **Gelon** (Gelæna), Teleclus (Telecta).

1871. Kirb., Syn. Cat. 294: uses it for all the above, and many more.

Gelon may be selected as type.

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* This name is an accidental error of Hübner's in copying from Cramer.

451. Euterpe.*

1832–33. Swains., Ill. ii. 74: **Tereas** (Terea). Sole species, and therefore type, as stated by Butler.

Used in same sense by Boisduval, Doubleday, and Herrich-Schaeffer. According to Kirby (Syn. Cat.), this name is preoccupied (but not in zoölogy): it falls, however, before Archonias (q. v.).

452. Euthalia.

1816. Hübn., Verz. 41: **Lubentina**, Adonia

1871. Kirb., Syn. Cat. 252: uses it for the above and others.

Lubentina may be taken as the type.

453. Euthymus.*

1872. Scudd., Syst. Rev. 56: *Phylæus*. Sole species and designated type.

The name falls before Hylephila.

454. Eutresis.

1847. Doubl., Gen. Diurn. Lep. 111: **Hypereia**. Sole species, and therefore type.

1871. Kirb., Syn. Cat. 19: the same.

455. Euxanthe.

1816. Hübn., Verz. 39: **Eurinome**. Sole species, and therefore type.

1871. Kirb., Syn. Cat. 228: the same and another.

See Anthora and Godartia.

456. Evenus.

1816. Hübn., Verz. 78: **regalis** (Endymion), Ganymedes. Regalis may be taken as the type.

See Eucharia, Endymion, and Arcas.

457. Everes.

1816. Hübn., Verz. 69: **Argiades** (Amyntas, Polysperchon). Sole species, and therefore type, as indicated by Scudder (Syst. Rev.).

458. Evonyme.

1816. Hübn., Verz. 61: **Amelia**, Sophonisba.

This generic name has never since been employed. Amelia may be taken as the type.

459. FABIUS.*

1837. Dunc., For. Butt. 167: *Hippona.* Sole species, and therefore type.

But as Fabius is one of the synonymes of Hippona, the name falls. See Consul, Helicodes, and Protogonius.

460. FAUNIA.*

1847. Poey, Mem. Soc. Econ. Habana, [2] iii. 178: *Orphise* (Orphisa). Sole species, and therefore type.

The details of Herrich-Schaeffer's reference (Schmett. Cuba, 5) are erroneous.

1867. Feld., Reise Novara, 406: Olympias, Persephone, Tithonia, Vemesia, Pomona, Araucana.

The name is preoccupied in Diptera (Rob.-Desv., 1830), and very near to Faunis (Hübn., Lep. 1816) and Faunus (Montf., Moll. 1810).

461. FAUNIS.*

1816. Hübn., Verz. 55: Eumeus (Eumea), Echo.

Preoccupied through Faunus (Montf., Moll. 1810). See Clerome.

462. FAUNULA.

1867. Feld., Reise Novara, 488: **Leucoglene.** Sole species, and therefore type, as stated by Butler.

463. FENISECA.

1869. Grote, Trans. Amer. Ent. Soc. ii. 308: **Tarquinius,** Porsenna. Tarquinius specified as type, as stated by Scudder.

464. FESTIVUS.*

1872. Crotch, Cist. Ent. i. 62: refers this name to Fabricius, and says that Latreille (1805) fixed the type as Plexippus; but see our introductory remarks.

465. GANORIS.*

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 61, 86: I. cratægi, *brassicæ*, rapæ, napi, Daplidice, cardamines, sinapis; II. Hyale, Palæno, rhamni. Brassicæ is specified as the type.

1872. Scudd., Syst. Rev. 41: designates rapæ as type, but erroneously. See Pieris.

Brassicæ having previously been made the type of Mancipium, this name falls, and cannot be employed again. See also Pontia.

466. GANYRA.

1820. Dalm. in Billb., Enum. Ins. 76: **Leucippe**, Croceus (Edusa), Hyale, Palæno (Paleno), Hecabe, Nise, Proterpia, Elathea, albula, Monuste, Pyranthe (Gnoma, Minna), **Amaryllis**, Crocale (Alcmeone), Scylla, Argante (Hersilia), Eubule, Trite, and a number of MS. species.

Amaryllis may be taken as the type.

467. GEGENES.

1816. Hübn., Verz. 107: **Pygmæus** and two MS. species. Pygmæus must therefore be considered the type.

1870. Butl., Ent. Monthl. Mag. vii. 93: specifies Pygmæus (Pygmæa) as type.

468. GEITONEURA.*

1867. Butl., Ann. Mag. Nat. Hist. [3] xix. 164: *Klugii*, Achanta.

1868. Ib., Ent. Monthl. Mag. iv. 196; and Cat. Sat. 166: specifies Klugii as type.

The name falls before Xenica (q. v.).

469. GERYDUS.

1836. Boisd., Spec. gén., pl. 7 C.: **Symethus**. Sole species, and therefore type.

Used for the same species by Doubleday (List). See Symetha and Miletus.

470. GLAUCOPSYCHE.

1872. Scudd., Syst. Rev. 33: **Lygdamus**, Pembina. Lygdamus specified as type.

471. GLOBICEPS.*

1869. Feld., Pet. Nouv. Ent. i. viii.: *paradoxa*. Sole species, and therefore type.

The generic name is preoccupied in Hemiptera (Lep.-Serv. 1825). See Pseudopontia and Gonophlebia.

472. GLYCESTHA.

1820. Dalm. in Billb., Enum. Ins. 76: cratægi, Hyparete (Hyparite), Pasithoe, **Java** (Coronea).

Java may be taken as the type.

473. GNATHOTRICHE.

1862. Feld., Wien. Ent. Monatschr. vi. 420, note: **exclamationis**. Sole species, and therefore type.

474. GNESIA.

1848. Doubl., Gen. Diurn. Lep. 141: Medea, Zetes (Menippe, Zetes), Persephone, Egina, Perenna, **Circeis.**

Circeis may be taken as the type.

475. GNOPHODES.

1849. Doubl., Gen. Diurn. Lep., pl. 61: **Parmeno.** Sole species, and therefore type.

1851. Westw., Gen. Diurn. Lep., 363: Parmeno, Chelys (Morpena).

1868. Butl., Ent. Monthl. Mag. iv. 194: designates Parmeno as type.

476. GODARTIA.*

1842. Luc., Ann. Soc. Ent. Fr. xi. 297: *madagascariensis.* Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 282; Eurinome, madagascariensis.

The name is very close to Gœdartia (Boie., Hym. 1841), though named after another person. It is, however, synonymous with Euxanthe, and must fall before it. See also Anthora.

477. GODYRIS.*

1870. Boisd., Lép. Guat. 33: *Duilia.* Sole species, and therefore type.

It falls before Hymenitis.

478. GONEPTERYX.*

1815. Leach, Edinb. Encycl. 716: *rhamni.* Sole species, and therefore type.

1827. Curtis, Brit. Ent. pl. 173: designates rhamni as the type.

1827. Steph., Ill. Brit. Ent. Haust. 8: uses it for rhamni only.

1840. Westw., Gen. Syn. 87 [Goniapteryx]: rhamni given as type.

1847. Doubl., Gen. Diurn. Lep. 69: uses it for many species with rhamni.

1853. Wallengr., Rhop. Scand. 145 [Goniopteryx]: rhamni.

1870. Butl., Cist. Ent. i. 35, 45: specifies rhamni as type.

The generic name falls, however, before Colias (q. v.). See also Gonoptera and Earina.

479. GONILOBA.

1852. Westw., Gen. Diurn. Lep. 512: Creteus, Celænus, Vespasius (Cassander), Parmenides, Bixæ, Apastus, Aulestes, Hylaspes, Pervivax, Scipio, Mercatus (fulgerator), Talus,

Corytas (Pyramus), Amyntas (Savignyi), Phidon* (Phedon), Cometes, Schonherri, Idas (Mercurius), Tityrus, Yuccae,* Olynthus,* Exadeus, Epitus,* Evadnes* (Evadne), Pomus (Comus), Brino,* dubius, Anaphus, Orchamus,* Pompeius (Archalaus), Ericus, Chromus, Alexis, Euribates, Salatis, Muretus, Ramusis, Midas (Rhetus), Ethlius* (Chemnis, Ethlius), Hesus, Corydon (Coridon), Lucasii (Lucas), Antoninus,* Salius,* Nyctelius, Dalmanni,* Basochesii, Fischeri,* Lesueuri, Bonfilius, Dan, Sergestus, Feisthamelii, Sabadius, Japetus (Nepos), Phineus, Lucretius, Minos, **Xanthaphes*** (Xanthoptes), Aristoteles, Justinianus, Lafrenayii, Fantasos, Helops, Phocus, Avitus, Crinisus, Ebusus, Psecas, Alcmon, Artemides, Zestos, Bathyllus (Bethyllus), Astylos,* Broteas,* Corytas, Vulpinus, Olenus,* Nicias, Godartii.

1869. Herr.-Schaeff., Prodr. iii. 69: gives a large number of species, including those of the above list which are followed by an asterisk.

1870. Butl., Ent. Monthl. Mag. vii. 56: uses it for Tityrus, Exadeus, and others not mentioned by Westwood.

None of Butler's species being congeneric with those employed in this group by Herrich-Schaeffer, Butler's action has no effect whatever upon the determination of a type. Of Westwood's species mentioned by Herrich-Schaeffer, Phidon, Ethlius, and Olenus are types of other genera. This group may be confined to Xanthaphes and allies. See Niconiades.

480. Goniurus.

1816. Hübn., Verz. 104: Simplicius, Dorantes, Brachius (Brachyus), **Cœlus**, Catillus, Proteus, Tarchon, Eudoxus, Orion.

1852. Westw., Gen. Diurn. Lep. 510 [Goniuris]: employs it for a dozen species, including all of the above.

1869. Butl., Cat. Fabr. Lep. 259 [Goniuris]: employs it for Proteus only.

1870. Ib., Ent. Monthl. Mag. vii. 56: specifies Simplicius as type.

But neither Proteus nor Simplicius can be taken as the type, since they are congeneric, and Proteus has been taken as the type of Eudamus, carrying with it most of Hübner's Goniuri. Cœlus may be taken as the type.

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* See the succeeding entry.

481. GONOPHLEBIA.

1870 (Aug.). Feld., Pet. Nouv. Ent. 95: **paradoxa**. Sole species, and therefore type.

Proposed to supplant Globiceps, preoccupied. Is it a butterfly? See also Pseudopontia.

482. GONOPTERA.*

1820. Dalm. in Billb., Enum. Ins. 76 [Gonrptera]: rhamni (rhemni), Cleopatra.

Falls before Colias (q. v.). See also Gonepteryx and Earina.

483. GONOPTERIS.*

1832. Gey. in Hübn., Zutr. iv. 34: *Pergæa*. Sole species, and therefore type.

The name is preoccupied through Gonoptera (Dalm., Lep. 1820, and Latr., Lep. 1825).

484. GORGO.*

1816. Hübn., Verz. 64: Ceto, Medusa, Œme (Psodea, Œme).

The name falls before Erebia. See also Marica, Syngea, Phorcis, Epigea, and Oreina.

485. GRAPHIUM.*

1777. Scop., Introd. 433: Medon and an immense number of wholly disconnected species, arranged in eight divisions.

None of these divisions (when they contain more than a single species) are homogeneous. Take, for example, the second, which among others contains Sarpedon [Papilionides], Mneme [Tribuni], populi [Archontes], and Clio [Hamadryades]; or the fourth with these: Euterpe [Stalachtis], Charithonia [a Heliconian], and Venilia [Athyma]. Every one of the families are represented. The genus must therefore be dropped as thoroughly discreditable to the author, even at the early time it was established.

486. GRAPTA.*

1837. Kirb., Faun. Bor. Amer. 292: *Progne* (c. argenteum). Sole species, and therefore type.

1848. Doubl., Gen. Diurn. Lep. 195: employs it for a number of species, including the above.

He gives Polygonia as a synonyme, but evidently at one time intended to use it in preference to Grapta, since he elsewhere in the text (p. 199) refers to this genus as Polygonia.

1861. Feld., Neues Lep. 12: uses it in the same sense.

It has been elsewhere very generally adopted, but is synonymous with Polygonia, and must fall before it. See also Comma.

487. Gynœcia.*

1844. Doubl., List Br. Mus. 88: *Dirce*. Sole species, and therefore type.

It has been used in the same sense by Westwood, Kirby, and Felder, the last of whom spells it Gynæcia; but it falls before Colobura (q.v.)

488. Gyrocheilus.

1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 267: **Patrobas.** Sole species and designated type.

489. Hades.

1851. Westw., Gen. Diurn. Lep. 435: **Noctula.** Sole species, and therefore type.

Used for the same species by Bates and Kirby. See Moritzia.

490. Hadothera.*

1820. Billb., Enum. Ins. 80: proposed, without reason, to supplant Danis. No species are referred to it.

491. Hæmatera.

1848. Doubl., Gen. Diurn. Lep., pl. 30: **Thysbe.** Sole species, and therefore type.

1849. Ib., ib. 231: Pyramus, Thysbe.

Subsequently used in the same sense by Felder and Kirby.

492. Hæmonides.

1816. Hübn., Verz. 101: **Cronis.*** Sole species, and therefore type.

493. Hætera.

1807. Fabr., Ill. Mag. vi. 284: **Piera,** diaphanus.

1820. Billb., Enum. Ins. 77: without apparent reason, but much according to his wont, changes the name to Pselna.

1836. Boisd., Spec. gén., pl. 9 B.: Piera is figured, and therefore this must be taken as type. It has been used by subsequent authors in the same sense.

1868. Butl., Ent. Monthl. Mag. iv. 195: designates Piera as type.

1872. Crotch, Cist. Ent. i. 66: says that Piera is type through Doubleday in 1846, overlooking Boisduval's action.

494. Hamadryas.

1806. Hübn., Tent. 1: **Io.** Sole species, and therefore type.

1832. Boisd., Astrol. 91: employs it for Zoilus and Assarica (Assaricus), which have no connection with Hübner's group.

Since used by many authors in the later sense. See also Inachis.

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* See note, p. 293.

495. Hamanumida.

1816. Hübn., Verz. 18: Veronica, **Dædalus** (Meleagris), Flegyas (Allica), Actoris (Actoria), Thasus (Thase), Ceneus (Lusia).

1871. Kirb., Syn. Cat. 249: employs it for Dædalus only, which therefore becomes type.

See also Canopus.

496. Hamearis.

1816. Hübn., Verz. 19: Abaris (Abarissa), **Epulus** (Epule), Lucina.

1830. Curtis, Brit. Ent., pl. 316: designates Lucina as the type; but Stephens's action in the previous year, in founding the genus Nemeobius, renders this nugatory.

1840. Westw., Gen. Syn. 88: specifies Lucina as type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 447: employs it for several species, including Epulus only of Hübner's species, and this therefore becomes the type.

497. Hames.*

1851. Boisd. MS. in Westw., Gen. Diurn. Lep. 366: mentioned by Westwood as synonymous with Cærois, but not otherwise referred to by any writer. Boisduval himself has never mentioned it, and no species have been referred to it.

498. Harma.*

1848. Boisd. in Doubl., Gen. Diurn. Lep., pl. 40: *Theobene*. Sole species, and therefore type.

1850. "Doubl." [but erroneously] in Westw., Gen. Diurn. Lep. 287: Theobene and others.

1861. Feld., Neues Lep. 33: divides the group into three sections, the first comprising Theobene.

The name is preoccupied by Arma (Hahn, Hemipt. 1833).

499. Hebomoia.

1816. Hübn., Verz. 96: **Glaucippe**, Leucippe.

1847. Doubl., Gen. Diurn. Lep. 62: the same.

1870. Butl., Cist. Ent. i. 37, 48: specifies Glaucippe as type.

See Iphias.

500. Hecaerge.*

1816. Ochs., Schmett. Eur. iv. 32: *celtis*. Sole species, and therefore type.

1816. Hübn., Verz. 100: Carinenta, celtis.

Besides the reasons given in the introduction for believing that Hübner's Verzeichniss did not appear until after 1816, which alone would be enough to give Ochsenheimer the preference in this case, Ochsenheimer's preface is dated in March and Hübner's in September. One must have borrowed from the other. It is beyond credence that both should have coined the same generic word for the same insects, unless there were some special significance in the name, as there is not. Hübner's genus was defined (briefly), while Ochsenheimer's was not; but the latter author gives a reason (an insufficient one) for changing the name of the earlier Libythea, just as he does in the case of Charaxes; and there can therefore be little doubt that the genus is to be credited to Ochsenheimer. *In that case*, the genus cannot stand, for celtis (which is generically distinct from Carinenta) had already been taken as the type of Libythea. See also Hypatus.

501. Hecalene.*

1844. [Boisd. in] Doubl., List Br. Mus. 112: *Clytemnestra.* Sole species, and therefore type.

But this name must fall before Hypna (q. v.), as pointed out by Westwood, in the Genera of Diurnal Lepidoptera, where Hecalene is credited to Boisduval.

502. Hectorides.

1822. Hübn., Index: **Agavus**, Brunichus.

1822–26. Ib., Exot. Schmett. ii.: Lysithous, Ascanius.

1825. Ib., Zutr. iii. 25: Proneus.

The choice of type must, of course, lie between Agavus and Brunichus, and Agavus may be selected.

503. Hedone.*

1872. Scudd., Syst. Rev. 58: *Brettus*, Præceps, Coscinia, Orono, Ætna. Brettus specified as type.

It falls before Thymelicus (q. v.).

504. Helcyra.

1860. Feld., Sitzungsb. Acad. Wien, xl. 450: **Chionippe.** Sole species, and therefore type.

1861. Ib., Neues Lep. 37, 44: the same.

505. Helias.*

1807. Fabr., Ill. Mag. vi. 287: no insects cited, excepting an unnamed MS. species.

The description is also entirely insufficient to give any clew to what Fabricius may have had in mind, and hence the name must be dropped.

1820. Billb., Enum. Ins. 80: proposes, for no reason, to change the name to Achna; he also mentions no species.

1867. Feld., Reise Novara, 531: uses it for seven new species, allied to Busiris and others.

1870. Butl., Ent. Monthl. Mag. vii. 98: specifies phalænoides as type.

1871. Kirb., Syn. Cat. 634: follows Butler, but questions whether it is used in the Fabrician sense.

See Achlyodes.

506. HELICODES.*

1844. [Boisd. in] Doubl., List Br. Mus. 112: *Hippona.* Sole species, and therefore type.

1850. Boisd. MS. in Westw., Gen. Diurn. Lep. 313: Westwood gives it as a synonyme of Protogonius.

1870. Boisd., Lép. Guat. 49: claims it as his own, placing the same species in it.

It falls, however, through Consul. See also Fabius and Protogonius.

507. HELICONIUS.

1805. Latr., Sonn. Buff. xiv. 108: **Antiochus** (Anthioca). Sole species, and therefore type.

1809. Ib., Gen. Crust. et Ins. iv. 200: divides the group in two sections, but does not specify Antiochus in either.

1810. Ib., Consid. 440: specifies Polymnia and Horta as types (!), these being the first species of each section in his previous work.

1815. Oken, Lehrb. i. 725: treats it as Latreille in his later works.

1817. Latr., Cuv. Règne Anim. iii. 549: employs it for a number of species, but Antiochus is not mentioned.

1823. Hübn., Zutr. ii. 31 [Heliconia]: employs it for Lansdorfii (Langsdorfii), which has nothing to do with the Fabrician genus.

1836. Boisd., Spec. gén., pl. 7 B. [Heliconia]: figures Dæta.

It is subsequently used for species allied to Anthioca by Doubleday, Bates, and others.

1872. Crotch, Cist. Ent. i. 60: refers the genus back to Linné [Heliconii], but erroneously, and says the type was fixed by Lamarck in 1801 as Psidii.

But Lamarck at this time only divided the genus Papilio into sections, giving them the Linnean names in the plural form, and specified Psidii as an example of Heliconii.

508. Helicopis.

1807. Fabr., Ill. Mag. vi. 285: **Cupido**, Acis (Gnidus).

1815. Oken, Lehrb. i. 722: uses it as a section of Emesis, referring to it the same species, together with Endymion.

1816. Hübn., Verz. 22: employs it for Cecilia (Cicilia), which is only distantly related to the Fabrician types.

1818. Hoffm. in Wied., Zoöl. Mag. i. ii. 98: refers the Fabrician species to it.

1836. Boisd., Spec. gén., pl. 3 A.: gives an illustration of Cupido, which therefore becomes type.

It has been used in same sense by later authors. See also Erotion and Hexuopteris.

509. Heliochlæna.*

1822. Hübn., Index: *Leucosia.* Sole species, and therefore type.

The name falls before Peplia. See Desmozona and Nymphidium.

510. Heliochroma.

1869. Butl., Cist. Ent. i. 15: **idiotica.** Sole species, and therefore type, as subsequently indicated by Butler. See p. 293.

511. Heliopetes.

1820. Billb., Enum. Ins. 81: **Arsalte** (niveus) and a MS. species. Arsalte therefore is the type.

See also Leucoscirtes.

512. Heliophorus.

1832. Gey. in Hübn., Zutr. iv. 40: **Epicles** (Belenus). Sole species, and therefore type.

See also Ilerda.

513. Heliornis.*

1820. Dalm. in Billb., Enum. Ins. 79: Laertes (Epistrophus), Menelaus (Menelaus, Nestor), Achilles (Helenor, Achilles).

This name is preoccupied in Birds (Bonn. 1790).

514. Hemerocharis.*

1836. Boisd., Spec. gén. 412: given only as a MS. synonyme of Leptalis by the author himself. It therefore cannot be used in this (or any other) sense.

515. Hemiargus.

1816. Hübn., Verz. 69: Bubastus, Parsimon (Celæus), Lysimon (Ubaldus), **Hanno**, Isis (Isarchus), Larydas, and a MS. species.

Hanno may be selected as the type.

516. Heodes.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 63, 91: Hippothoe (Hippothoe, Chryseis), Virgaureæ, **Phlæas**, Helle, Dorilas (Garbas), rubi.

1820. Billb., Enum. Ins. 80: the same, excepting rubi, and others.

1835. Vill.-Guén., Lép. Eur. 32: Helle, Phlæas, and other coppers.

Phlæas may be taken as the type. See Lycæna.

517. Heraclides.

1816. Hübn., Verz. 83: **Thoas** (Oxilus, Thoas), Menestheus, Pelaus, Demolion (Cresphontes), Phorcas.

Thoas may be taken as the type. See also Thoas.

518. Herona.

1848. Doubl., Gen. Diurn. Lep. pl. 41: **Marathus**. Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 293: the same.

519. Herpænia.*

1870. Butl., Cist. Ent. i. 38, 52: ***Eriphia*** (Tritogenia). Sole species and designated type.

The name must fall before Picanopteryx.

520. Hesperia.

1793. Fabr., Ent. Syst. iii. i. 258: established upon all the Rurales and Urbicolæ known to him, three hundred and forty-nine names (231 Rurales, 118 Urbicolæ), the two groups commencing respectively with Cupido and exclamationis among the latter **malvæ**.

1798. Cuv., Tabl. Élém. 592: cites malvæ as an example and the only one. This, therefore, becomes the type, being one of those used by Fabricius.

1807. Fabr., Ill. Mag. vi. 285: employs it for Amor, Helius, Faunus, Vulcanus, Marsyas, Bœtica, Acmon (Æmon), Thysbe, Thetys (Æsopus), and Pretus, all Rurales, to which group, but for Cuvier's action, Hesperia would have to be restricted; as it is, Fabricius's action has no effect.

1810. Latr., Consid. 440: specifies Proteus, malvæ, and Morpheus (Steropes) as types.

1815. Oken., Lehrb. i. 720: employs it for Helle and allies!

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 200: specifies comma as type, but erroneously.

1816. Lam., Hist. Nat. An. sans Vert. iv. 20: employs it for malvæ and others.

1816. Hübn., Verz. 25: uses it for various Vestales, following Fabricius' own tardy limitation, although not in precisely the same sense.

1820. Billb., Enum. Ins. 81: some Urbicolæ, among them malvæ.

1820. Oken, Naturg. f. Schulen, 788: employs it for some Ephori.

1820–21. Swains., Zoöl. Ill. i. i. 28: specifies comma as the type, but erroneously.

1833. Curtis, Brit. Ent., pl. 442: also designates comma as the type.

1837. Sodoffsk., Bull. Mosc. x. 82: proposes to supplant this name by Symmachia (q. v.).

1840. Ramb., Faun. Ent. Andal. 312 [probably unpublished]: uses it for a number of species, including malvæ (Alveolus).

1852. Westw., Gen. Diurn. Lep. 525: employs it for a heterogeneous group of Urbicolæ, not including malvæ.

1858. Ramb., Cat. Lép. Andal. 88: limits it wrongly to Nostrodamus (Nostradamus).

1858. Kirb., Cat. Brit. Rhop.: limits it to comma.

1869. Butl., Cat. Fabr. Lep. 269: employs it for exclamationis and others, but not for malvæ.

1870. Ib., Ent. Monthl. Mag. vii. 58: specifies exclamationis as the type, erroneously.*

1870. Kirb., Journ. Linn. Soc. Lond. x. 500: says that Proteus seems to be Latreille's type, and Alcides that of Fabricius.

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* Butler (Lep. Exot. 166, note) says of Hesperia: "Fabricius described the genus in his Entomologia Systematica, vol. iii., Gloss. 1, p. 325 (1793), and gave *no type*, but used the following words in his description — 'Antennæ clava elongata, sæpius uncinata.' These words at once fix the type as somewhere amongst the *Hesperiæ urbicolæ* (notwithstanding the fact that, in his Systema Glossatorum, Fabricius refers it to the *rurales*). The *Hesperia* of Cuvier has for its type *H. Malvæ* (as Mr. Crotch has pointed out, Cist. Ent. p. 62); but *Pyrgus Malvæ* (of all the *Hesperiæ urbicolæ*) is about the worst to have chosen as the type, for it *does not fit* the Fabrician description. Therefore it is clear that *P. Malvæ* could not have crossed the mind of Fabricius when he penned his description, and *cannot be* his type: later authors have referred the dark-coloured species of *Pamphila* and *Carystus* to *Hesperia*, evidently taking *H. Exclamationis* as the type, it being the first species which he describes under his *urbicolæ;* but as *H. Exclamationis* turns out to be an *Ismene*, and not, as formerly supposed, a *Pamphila*, I have taken *I. Exclamationis* as the type. The first of the *Hesperiæ Rurales* is a species of the family Erycinidæ."

1871. Ib., Syn. Cat. 611: places a large number of species in the group, including malvæ, but excluding comma, exclamationis, and Proteus, showing that he doubtless considers malvæ as the type.

1872. Crotch, Cist. Ent. i. 62: says that malvæ is the type, through Cuvier, 1799.

1872. Scudd., Syst. Rev. 52: specifies malvæ as the type.

All of the species indicated above under this heading, excepting some of those not specified by name, were placed by Fabricius under Hesperia at its establishment. See Pyrgus, Scelothrix, and Syrichtus.

521. Hesperilla.

1868. Hewits., Hundr. Hesp. 37: **ornata**, Halyzia, Doubledayi (Dirphia), Donnysa, Peronii (Doclea). Ornata specified as type.

1871. Kirb., Syn. Cat. 622: uses it in the same sense.

See Telesto.

522. Hesperocharis.

1862. Feld., Verh. zoöl.-bot. Gesellsch. Wien, xii. 493: I. **Erota**, Marchalii, Helvia, Nera, Anguitia; II. Gayi. See p. 293.

1867. Herr.-Schaeff., Prodr. ii. 17: uses it in the same sense.

1870. Butl., Cist. Ent. i. 34, 42: designates Erota as type.

523. Hestia.

1816. Hübn., Verz. 15: similis, assimilis, Idea, **Lynceus** (Lyncea), Ismare, Menelaus (Ephyre), Juventa, Plexippus (Thoe).

1844. Doubl., List Br. Mus. 52: uses it for Idea, Lynceus, and two others not of Hübner's list.

1847. Doubl., Gen. Diurn. Lep. 94: uses it in the same sense.

1871. Kirby, Syn. Cat. 1: follows Doubleday.

Since Lynceus is generically distinct from Idea, it may be taken as the type. See Idea and Nectaria.

524. Hestina.

1850. Westw., Gen. Diurn. Lep. 281: I. **assimilis**, persimilis, consimilis, Nama; II. Nyctelius, Pimplea?

1861. Feld., Neues Lep. 25: limits it to the first section, which he again divides into two, using assimilis and Nama as the types of the two divisions.

1871. Kirb., Syn. Cat. 227: uses it in the Felderian sense.

Assimilis may be considered as the type.

525. HETEROCHROA.

1836. Boisd., Spec. gén., pl. 4 B.: **Serpa.** Sole species, and therefore type.

1844. Doubl., List Br. Mus. 106: employs it for a great number of species, including Serpa.

1850. Westw., Gen. Diurn. Lep. 276: uses it in the same sense.

1861. Feld., Neues Lep. 28: divides it into two sections.

According to Kirby (Syn. Cat.), the name is preoccupied; but only in botany, as he informs me by letter.

526. HETERONYMPHA.

1858. Wallengr., K. Vet. Akad. Förhandl. xv. 78: **Merope**, Abeona.

1868. Butl., Ent. Monthl. Mag. iv. 195; and Cat. Sat. 99: specifies Merope as type.

See also Tisiphone, Hipparchioides, and Xenica.

527. HETEROPSIS.

1850. Boisd. in Westw., Gen. Diurn. Lep. 323: **Drepana.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 96 (referred to Westwood, not Boisduval): the same.

528. HETEROPTERUS.

1806. Dum., Zoöl. Anal. 271: no species mentioned; he refers to it all Urbicolæ with wings *croisées*, the rest being grouped under Hesperia.

1823. Ib., Consid. 222, pl. 41: **Morpheus** given as an example. It is therefore the type.

1832. Dup., Pap. France, Diurn. Suppl. 413: employs it for Morpheus (Aracinthus), Palæmon (Paniscus), and sylvius.

1840. Ramb., Faun. Ent. Andal. 305 [unpublished ?]: refers to it lineola and four other species no more nearly allied to Morpheus than it is. So also in his Faun. Andal.

1853. Wallengr., Scand. Rhop. 250: limits it to sylvius.

1858. Ib., Rhop. Caffr. 46: uses it, more correctly, for Metis and Willenii.

1870. Kirb., Journ. Linn. Soc. Lond. x. 500: says that Morpheus (Speculum) is the type. See also Cyclopides.

529. HEUREMA.*

1867. Herr.-Schaeff., Prodr. ii. 8: *impura.* Sole species, and therefore type.

Preoccupied by Eurema (Hübn., Lep. 1816).

530. Hewitsonia.

1871. Kirb., Syn. Cat. 426: **Boisduvalii.** Sole species, and therefore type.

Proposed to replace Corydon, preoccupied.

531. Hexuopteris.*

1816. Hübn., Verz. 22: Endymion (Endymisena), Cupido (Cupidina).

This name falls before Helicopis. See also Erotion.

532. Hipio.

1816. Hübn., Verz. 56: **Constantia** (Constantina), Leda.

1865. Herr.-Schaeff., Prodr. i. 61: employs it for other butterflies, Crishna and a MS. species.

1868. Butl., Ent. Monthl. Mag. iv. 194: designates Constantia as the type.

533. Hiposcritia.

1832. Gey. in Hübn., Zutr. iv. 16: **Pandione.** Sole species, and therefore type.

534. Hipparchia.

1807. Fabr., Ill. Mag. vi. 281: Hermione, Statilimus (Fauna), Maera, Ligea, Epiphron, Galathea, Tithonus (Pilosellæ), **Hyperanthus**, Rumina.

1815. Leach, Edinb. Encycl. 717: uses it for Galathea, Hyperanthus, Tithonus (Pilosellæ), and others not of Fabricius' list.

1816. Ochs., Schmett. Eur. iv. 19: divides the group into seven "families," and places in it all the European Satyrids.

1816. Hübn., Verz. 57: uses it for Statilimus (Arachne) and others not used by Fabricius.

1828. Curtis, Brit. Ent., pl. 205: designates Jurtina (Janira) as type, but it was not one of the Fabrician species.

1837. Sodoffsk., Bull. Mosc. x. 81: proposes to replace the name by Melania (q. v.).

1840. Westw., Gen. Syn. 88: specifies Megæra as type.

1844. Doubl., List Br. Mus. 129: uses it for a large number, including Statilimus (Fauna) and others, but not Hyperanthus.

1858. Ramb., Cat. Lép. Andal. 22: uses it for five species, including only Tithonus of those mentioned by Fabricius.

1868. Butl., Ent. Monthl. Mag. iv. 194; Cat. Sat. 50: specifies Hermione (fagi) as type, but incorrectly.

548. Hypatus.

1825. Hübn., Catal. Franck, 85: Celtis, **Carinenta.**

Celtis being already type of Libythea, Carinenta must be taken as the type of this. See Hecaerge and Libythea.

549. Hypermnestra.

1851. Heyd., Lep. Eur. Cat. 3d ed. 16: **Helios.**

1852. Westw., Gen. Diurn. Lep. 530: the same.

Subsequently used similarly by Felder, Kirby, etc. See Ismene.

550. Hyphilaria.

1816. Hübn., Verz. 26: **Nicias** (Nicia). Sole species, and therefore type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 420: employs it for the same and others, in which he is followed by Kirby (Syn. Cat.).

551. Hypna.

1816. Hübn., Verz. 56: **Clytemnestra.** Sole species, and therefore type.

Used in the same sense by Westwood, Felder, Butler, and Kirby. See Hecalene.

552. Hypochrysops.

1865. Feld., Reise Novara, 251: Doleschalii, Theon, **Anacletus,** Eucletus, Pythias, Protogenes, Chrysanthis.

1871. Kirb., Syn. Cat. 378: employs it for the same and others.

Anacletus may be taken as the type.

553. Hypocysta.

1850–51. Westw., Gen. Diurn. Lep., pl. 67: **Euphemia.** Sole species, and therefore type.

1851 (June). Ib., ib. 397: Irius, Euphemia.

1865. Herr.-Schaeff., Prodr. i. 60: employs it for this and others, including Irius (Adiante).

1868. Butl., Ent. Monthl. Mag. iv. 196; and Cat. Sat. 167: wrongly specifies Irius as type, for the context shows that the plate was printed before the text.

554. Hypolimnas.

1816. Hübn., Verz. 45 (spelled both Hypolimnas and Hipolimnas): Antilope, Alimena (Velleda, Alimena, Porphyria), Bolina (Eriphile, Perimele, Manilia, Antigone, Alcmene, Iphigenia), **Pandarus** (Pipleis).

1822–25. Ib., Exot. Schmett. ii.: Pandarus (Pipleis).
1871. Kirb., Syn. Cat. 224: employs it for the same and others.

Most of the species fall into the earlier Apatura, but the name may be retained for Pandarus and its allies, in accordance with Hübner's later use of it.

555. Hypolycæna.

1862. Feld., Wien. Ent. Monatschr. vi. 293: Tmolus, **Sipylus** (Tharrytas), Astyla.
1871. Kirb., Syn. Cat. 406: employs it for the same and others.

Sipylus may be taken as the type.

556. Hypophylla.

1836. Boisd., Spec. gén., pl. 4 C.: **Zeurippe** (Zeurippa).
1847. Doubl., List Br. Mus. 9: employs it for this and others.
1867. Bates, Journ. Linn. Soc. Lond. ix. 446: uses it similarly.

557. Hypothyris.

1822. Hübn., Index, 5: **Ninonia.** Sole species, and therefore type.

See Hyaliris.

558. Hyreus.*

1816. Hübn., Verz. 70: Lingeus, Palemon, Misenes.

The name is preoccupied in Birds. (Steph. 1815).

559. Idaides.

1816. Hübn., Verz. 85: **Codrus**, Nireus.

Codrus may be taken as the type.

560. Idea.*

1807. Fabr., Ill. Mag. vi. 283: *Idea.* Sole species, and therefore type.

Subsequently used by Godart and others, but the name cannot stand, from having been borrowed from the species on which it is founded. See Nectaria and Hestia.

561. Ideopsis.

1858. Horsf., Cat. Lep. E. Ind. Co. i. 133: **Gaura**, Daos.
1871. Kirby, Syn. Cat. 2: employs it for the same and others.

Gaura may be taken as the type.

562. Idiomorphus.*

1861. Doum., Rev. Mag. Zoöl. [2] xii. 174: *Hewitsonii.* Sole species, and therefore type, as subsequently specified by Butler.

Mr. Kirby informs me that the name is preoccupied in Coleoptera (Chaud. 1846). See Bicyclus.

576. Isoteinon.

1862. Feld., Wien. Ent. Monatschr. vi. 30: **lamprospilus** (lamprosilus). Sole species, and therefore type.

1871. Kirb., Syn. Cat. 625: the same and another species.

577. Issoria.

1816. Hübn., Verz. 31: Egista, Iole (Anticlia), **Lathonia**.

1850. Steph., Cat. Brit. Lep. 14: uses it for Lathonia only.

In this he is followed by Kirby (1858), and this therefore becomes the type.

578. Itanus.

1861. Feld., Neues Lep. 34: Acouthea, Garuda, Phemius, Salia, **Anosia**. Anosia may be taken as the type.

The name is too close to Itamus (Schmidt-Goebel, Col. 1846).

579. Ithobalus.

1816. Hübn., Verz. 88: **Polydamas**, Crassus, Belus, Lycidas (Lycidas, Erymanthus), Numitor.

Polydamas may be taken as the type.

580. Ithomeis.

1862 (Sept.). Bates, Trans. Linn. Soc. Lond. xxiii. 541: **Aurantiaca**, Stalachtina, Heliconina, mimica, Satellites.

Aurantiaca may be taken as the type. See Ithomiopsis.

581. Ithomia.

1816. Hübn., Verz. 9: Drymo, Euritea, **Doto**, Cymo.

1821. Ib., Index: Cymo, Doto.

1822? Ib., Samml. Exot. Schmett. text: Doto only, which thereby becomes type. [See Note, p. 293.]

1844. Doubl., List Br. Mus. 57: Drymo, Euritea, and others.

1847. Ib., Gen. Diurn. Lep. 125: uses it in the same sense.

1862. Bates, Linn. Trans. xxiii. 537: Doto, Cymo, and others.

1871. Kirb., Syn. Cat. 26: all of Hübner's and others.

1872. Butl.-Druce, Cist. Ent. i. 95: specify Drymo as type.

582. Ithomiola.

1865. Feld., Reise Novara, 311: **floralis**. Sole species, and therefore type.

Used for same species only, by Bates and Kirby. See Compsoteria.

583. Ithomiopsis.*

1862 (Dec.). Feld., Wien. Ent. Monatschr. vi. 411: Corena, Astræa.

Stated by Bates to be synonymous with Ithomeis (q. v.).

1847. Doubl., List Br. Mus. 26: employs it for Hymen (Liger) and others, not including Helius.

It is used in Hübner's sense by several authors.

571. Iphias.*

1836. Boisd., Spec. gén. 595: Glaucippe, Leucippe.

Used by Doubleday (1844), but falls before Hebomoia, and the name is preoccupied through Iphius (Dej., Col. 1833).

572. Iphiclides.

1816. Hübn., Verz. 82: Dolicaon, Antiphates, Nomius (Meges), Protesilaus, **Podalirius**, Ajax, Aristeus, Sinon, Antiphates (Pompilius), Antheus, Agamemnon.

1850. Steph., Cat. Brit. Lep. 251: employs it, as does Kirby in 1858, for Podalirius (Podalirius, Feisthamelii), so that this becomes the type, as stated by Scudder (1872).

See Podalirius and Papilio.

573. Isapis.

1847. Doubl., List Br. Mus. 18: **Agyrtus**. Sole species, and therefore type.

Used for same species by Westwood, Bates, and Kirby.

574. Ismene.

1820–21. Swains., Zoöl. Ill. i. 16: **Oedipodia**. Sole species, and therefore type.

1846. Nickerl, Stett. Ent. Zeit. vii. 207: employs it for Helios, a totally different insect. See Hypermnestra.

1848. Ménétr., Mem. Acad. St. Petersb. [6] Sc. Nat. vi. 274: the same.

1852. Westw., Gen. Diurn. Lep. 514: employs it in the Swainsonian sense for a dozen species.

1856. Gray, Pap. Brit. Mus. 77; and List Pap. 92: uses it again for Helios.

1869. Herr.-Schaeff., Prodr. iii. 54: without indicating any species, uses it as Swainson does.

1871. Staud., Catal. 2: again reverts to Nickerl's use.

1871. Kirb., Syn. Cat. 581: uses it correctly.

575. Isodema.

1863. Feld., Wien. Ent. Monatschr. vii. 109, note: proposes the name for Paraplesia (preoccupied), without indication of species. **Adelma**, being the type of Paraplesia (q. v.), becomes the type of this.

1850. Steph., Cat. Brit. Lep. 2 [Jasonides]: Machaon.
So also Kirby (1858).

Machaon, however, had already been made the type of Princeps: the other species, excepting Glaucus, are congeneric, and hence this must be taken as the type. See Euphœades.

591. Junonia.

1816. Hübn., Verz. 34: Aonis, **Lavinia**, Orithya (Orithya, Ocyale, Isocratia), Clelia, Erymanthis (Lotis), Œnone.

1849. Doubl., Gen. Diurn. Lep. 206: places in his typical section all the species of Hübner excepting Erymanthis, besides others not mentioned by him.

1861. Feld., Neues Lep. 13: divides the group into two sections, in the second of which he places two species, referred by Doubleday to his typical section. None of Hübner's species are specially designated.

1871. Kirb., Syn. Cat. 186: follows Doubleday.

1872. Scudd., Syst. Rev. 22: designates Lavinia as the type.

See Alyconeis.

592. Kallima.

1849. Doubl., Gen. Diurn. Lep., pl. 52: Rumia, **Paralekta**.

1850. Westw., Gen. Diurn. Lep. 324: nine species are given, including the above.

The question of type is a somewhat peculiar one. The "Paralekta" of Doubleday is considered by Westwood to be distinct from "Paralekta" of Horsfield, and the same as "Horsfieldii" of Kollar. Kirby (Syn. Cat. 193), on the other hand, makes "Paralekta" of Doubleday the same as the "Paralekta" of Horsfield; and the "Paralekta" of Westwood (together with the "Horsfieldii" of Kollar), the same as the "Inachis" of Boisduval, placed as a possible synonyme of "Paralekta." Now Westwood regards *his* "Paralekta" as type. If, however, Westwood's "Paralekta" is not the "Paralekta" of Doubleday, it could not become the type of the genus, because not mentioned in the first instance. If the same, it would have to be taken as type; consequently it would best be considered the type. The question, however, is still further complicated by the following:—

1861. Feld., Neues Lep. 14: refers to it only Inachis and Rumia.

If Inachis (which includes the "Paralekta" of Westwood) is distinct from the Paralekta of Doubleday, and Westwood's decision of a type is thereby ruled out of place, then Rumia becomes the type. The question is, in reality, of little importance, since all the species mentioned are congeneric in the strictest sense, and variety of opinion as to specific alliances does not affect the generic nomenclature.

1871. Kirb., Syn. Cat. 193: employs it for all these and another.

593. KRICOGONIA.

1863. Reak., Proc. Ent. Soc. Phil. ii. 355: **Lyside**, Menippe (Leachiana). Lyside specified as type.

1870. Butl., Cist. Ent. i. 36, 46: Lyside specified as type.

594. LACHNOPTERA.

1847. Doubl., Gen. Diurn. Lep., pl. 22: **Iole.** Sole species, and therefore type.

1848. Ib., ib. 161: the same.

595. LÆOSOPIS.

1858. Ramb., Cat. Lép. Andal. i. 33: **roboris.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 377: the same, and another.

596. LAERTIAS.

1816. Hübn., Verz. 84: Ulysses (Ulysses, Diomedes), **Philenor,** Menestheus (Cresus), Palinurus (Regulus), Polytes (Pamnon, Cyrus), Merope (Brutus).

1872. Scudd., Syst. Rev. 43: specifies Philenor as the type.

597. LAMPIDES.

1816. Hübn., Verz. 70: Numereus, **Ælianus** (Zethus), Helius, Balliston (Baaliston), Bœticus, Plato, Archias (Archius), Celeno (Celerio), Aratus.

1869. Butl., Cat. Fabr. Lep. 163: employs it for nineteen species, including Minereus, Ælianus, Bœticus, Plato, and Celeno.

1870. Newm., Brit. Butt. 117: employs it for Bœticus only.

It cannot be employed for Bœticus, as this became in 1810 the type of Polyommatus. Ælianus may be taken as the type.

598. LAMPROPTERA.*

1832. Gray, in Griff. An. Kingd., pl. 102, fig. 4: *Curius.* Sole species, and therefore type.

The same species is the type of Leptocircus (q. v.) published at about the same time: perhaps it is impossible to discover which is earlier, but this name is too close, in any case, to Lampropteryx (Steph., Lep. 1829) to stand. Leptocircus is also preferred to this by Gray himself in 1856 (Pap. Brit. Mus.).

599. LAMPROSPILUS.

1832. Gey. in Hübn., Zutr. iv. 30: **Genius.** Sole species, and therefore type.

Subsequently used in same sense by Herrich-Schaeffer and Kirby

600. LAOGONA.*

1836. Boisd., Spec. gén., pl. 6 B.: *Hypselis.* Sole species, and therefore type.

Subsequently used in same sense by Doubleday and Felder, but the name falls before Symbrenthia (q. v.).

601. LAPARUS.*

1820. Billb., Enum. Ins. 77: Rhea (Sara), Erato (Doris), Phyllis, Melpomene.

The name falls before Sicyonia, Migonitis, and Sunias.

602. LARINOPODA.

1871. Butl., Trans. Ent. Soc. Lond. 172: **lycænoides.** Sole species, and therefore type.

603. LASAIA.*

1867. Bates, Journ. Linn. Soc. Lond. ix. 397: Meris, Cleades (Cleadas).

1871. Kirb., Syn. Cat. 321: the same.

But this name cannot stand, because preoccupied through Lassæa (Brown, Moll. 1827) and Lasia (Wied., Dipt. 1824, and Hope, Col. 1840).

604. LASIOMMATA.

1840. Westw. in Westw.-Humphr., British Butterfl. 65: Ægeria, **Megæra.**

1844. Doubl., List Br. Mus. 134: employs it for Ægeria, Megæra, and other insects not specified by Westwood.

1850. Steph., Cat. Brit. Ent. 6, 254: employs it for Ægeria, Megæra, and Mæra only.

1851. Westw., Gen. Diurn. Lep. 385: employs it for the same and others.

As Ægeria is the type of Pararge, Megæra must be taken as the type of this genus. Butler, in his Catalogue of Satyridæ and elsewhere, has sunk this name under Pararge, apparently on the false principle that the first species must be taken as the type; and he has founded on the second species of this list, and on others, a genus Amecera (q. v.), which must certainly fall, unless some of its other species are generically distinct from Megæra.

605. LASIOPHILA.

1859. Feld., Wien. Ent. Monatschr. iii. 325: **Cirta,** Circe. Felder remarks that the species resemble, in habitus and coloring, the species of Pronophila of the group of Zapatoza.

1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 268; also (1868) Ent. Monthl. Mag. iv. 196, and Cat. Sat. 181: specifies Zapatoza as type, of course erroneously.

1871. Kirb., Syn. Cat. 107: employs the name for all the species mentioned above, and others.

Cirta may be considered the type.

606. Lebadea.

1861. Feld., Neues Lep. 28: **Ismene**, Alankara, Martha.

1871. Kirb., Syn. Cat. 230: the above and Paduka.

Ismene may be taken as the type.

607. Lemonias.

1806. Hübn., Tent. 1: **Maturna**. Sole species, and therefore type.

1818. Ill., Wied. Zoöl. Mag. i. ii. 99: Lamis and others, wholly unrelated to the above.

1847. Doubl., List Br. Mus. 16: uses it in the Illigerian sense for Epulus and others.

1851. Westw., Gen. Diurn. Lep. 457: uses it in a similar way for Chia and six others.

1867. Bates, Journ. Linn. Soc. Lond. ix. 446: extends it greatly, also using it for the Vestales.

1871. Kirb., Syn. Cat. 322: uses it in the Westwoodian sense, and refers the genus to him!

See also Polystichtis, Calospila, Melitæa and Mellida.

608. Leodonta.

1870. Butl., Cist. Ent. i. 34, 40: **Dysoni**, Tagaste, Tellane. Dysoni specified as type.

609. Leonte.*

1816. Hübn., Verz. 52: Menelaus (Nestira), Achilles (Deidamia), Menelaus (Menelae), Achilles (Achilleja), Hecuba, Telemachus (Telemache).

One of the synonymes of Achilles is Leonte Hübn. The generic name being therefore drawn from, or at least the same as, one of the names previously in use for one of the species upon which it is founded, it must be dropped.

610. Lepricornis.

1865. Feld., Reise Novara, 307: **melanchroia**. Sole species, and therefore type.

Used for this species only, by Bates and Kirby.

611. Leptalis.

1823. Dalm., Anal. Ent. 40: **Astynome,** Amphione. Astynome specified as type.

1836. Boisd., Spec. gén. 412: uses it for the above and many others.

1844. Doubl., List Br. Mus. 22: makes a similar use of it.

1847. Ib., Gen. Diurn. Lep. 35: uses it similarly.
See Hemerocharis.

612. Leptidia.

1820. Billb., Enum. Ins. 76: **sinapis.** Sole species, and therefore type.

Never since used, but should certainly be restored. See Leptoria and Leucophasia.

613. Leptocircus.

1832–33. Swains., Zoöl. Ill. ii. 106: **Curius.** Sole species, and therefore type.

Frequently used since in the same sense. See Lamproptera.

614. Leptoneura.*

1857. Wallengr., Rhop. Caffr. 31: *Clytus.* Sole species, and therefore type, as stated by Butler.

It should fall, however, before Dira (q.v.).

615. Leptophobia.

1870. Butl., Cist. Ent. i. 35, 45: **Eleone,** Penthica (Pentica), Balidia, Aripa (Arapa), Pylotis. Eleone specified as type.

616. Leptoptera.*

1842. Boisd. in Lucas, Ann. Soc. Ent. Fr. [1] xi. 298: *decora.* Sole species and designated type.

The species was at that time inedited, and before it was published Boisduval had changed the name to Amnosia (q.v.).

617. Leptoria.*

1841. Westw., Brit. Butt. 31: *sinapis* (candida). Sole species, and therefore type.

Falls before Leptidia. See also Leucophasia and Leptosia, for the latter of which it was probably a misprint.

618. Leptosia.

1816. Hübn., Verz. 95: sinapis (lathyri), Alcesta, **Xiphia** (chlorographa), Brephos.

1858. Kirb., List Brit. Rhop.: employs it for sinapis (candida, erysimi).

1870. Butl., Cist. Ent. i. 39, 54: specifies sinapis (lathyri) as type, but wrongly, as this was already the type of three different genera! See Leptidia.

Sinapis was taken as type of Leptidia in 1820, Brephos has belonged to Leucidia since 1847, Alcesta and Xiphia are congeneric, and Xiphia may be taken as the type. See Nina and Nychitona.

619. Lerema.

1872. Scudd., Syst. Rev. 61: **Accius**, Hianna, Pattenii. Accius specified as type.

620. Lerodea.

1872. Scudd., Syst. Rev. 59: **Eufala**, fusca, Inca. Eufala specified as type.

621. Lethe.

1816. Hübn., Verz. 56: **Europa.** Sole species, and therefore type, as stated by Butler. See Debis.

622. Lethites (fossil). See Satyrites.

623. Leucidia.

1847. Boisd. in Doubl., Gen. Diurn. Lep. 77: **Elvina**, Brephos.
1867. Herr.-Schaeff., Prodr. ii. 8: Brephos, Leucoma (Elphos).
1870. Butl., Cist. Ent. 35, 43: specifies Leucoma (Elphos) as type, but of course erroneously.

Elvina may be taken as the type.

624. Leucochitonea.

1857. Wallengr., Rhop. Caffr. 52: **Levubu.** Sole species, and therefore type, as stated by Butler.

Since used by authors in too extended a sense.

625. Leuconea.*

1837. Donz., Ann. Soc. Ent. Fr. vi. 80: *cratægi.* Sole species, and therefore type.
1858. Ramb., Catal. Lép. Andal. 54: uses it in the same way.

The name falls before Aporia.

626. Leucophasia.*

1827. Steph., Ill. Brit. Ent. Haust. i. 24: *sinapis.* Sole species, and therefore type, as specified by Westwood (Gen. Syn. 87).

Used in same sense by many subsequent authors. Falls before Leptidia. See also Leptoria.

627. Leucoscirtes.*

1872. Scudd., Syst. Rev. 52: *ericetorum*, Arsalte (nivea), Oceanus. Ericetorum specified as type.

The name falls before Heliopetes.

628. Leucothyris.*

1870. Boisd., Lép. Guat. 32: *Ilerdina.* Sole species, and therefore type.

This name is too close to Leucothyreus (MacL., Col. 1819) to be used.

629. Lexias.

1832. Boisd., Voy. Astrol. 125: **Æropus.** Sole species, and therefore type.

1861. Feld., Neues Lep. 36: places this species in a first section, Dirtea (Dirtea, Boisduvalii) in a second.

630. Libythea.

1807. Fabr., Ill. Mag. vi. 284: **celtis**, Carinenta.

1810. Latr., Consid. 440: specifies celtis as the type.

1820. Billb., Enum. Ins. 79: changes the name, for no reason, to Chilea.

1828. Boit., Man. Ent. ii. 299 [Libythæus]: celtis.

It has been used constantly by all authors in much the same sense.

1872. Crotch, Cist. Ent. i. 66: states that celtis is the type, through Latreille, 1810.

1872. Scudd., Syst. Rev. 28: specifies Carinenta as type, erroneously. See Hypatus aud Hecaerge.

631. Libythina.

1861. Feld., Neues Lep. 49: **Cuvieri.** Sole species, and therefore type.

632. Licinia.*

1820–21. Swains., Zoöl. Ill. i. i. 15: *Melite.* Sole species and designated type.

Subsequently, in the same series (i. ii. 91; i. iii. 124), Amphione and Critomedia (Crisia) are given. An allied species is Licinia of Cramer, doubtless intended by Swainson to be included in the group, and from which the name was drawn; on which account the name should be dropped. It is also preoccupied in Mollusks (Brown, 1756). See Enantia.

633. Limenitis.

1807. Fabr., Ill. Mag. vi. 281: populi, Niavius, **Camilla.**

1815. Leach, Edinb. Encycl. 718: employs it for Camilla only, so that this becomes the type. [See Note, p. 293.]

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 56 [Limonitis]: specifies populi as the type. See Najas.

1816. Hübn., Verz. 44: employs it for Camilla, populi, and two others.

1820. Billb., Enum. Ins. 78 [Limonetes]: uses it for populi and others.

1832. Dup., Pap. France, Diurn. Suppl. 400: uses it for Sibylla, Camilla, Lucilla, and aceris.

1832. Renn., Consp. 11 [Leminitis]: populi, etc.

1840. Westw., Gen. Syn. 87: specifies Camilla as type.

1844. Doubl., List Br. Mus. 93: employs it for Camilla and others, while populi is placed under Nymphalis.

1850. Westw., Gen. Diurn. Lep. 274: regards populi as the type.

1872. Crotch, Cist. Ent. i. 66: regards populi as the type, through Dalman, 1816, overlooking Leach's previous action.

634. Limnæcia.*

1872. Scudd., Syst. Rev. 26: *Harrisii*. Sole species and designated type.

This falls before Cinclidia (q.v.).

635. Limnas.

1806. Hübn., Tent. i.: **Chrysippus.** Sole species, and therefore type.

1836. Boisd., Spec. gén., pl. 4 C.: Pixe, a totally different insect from that of Hübner. See Melanis.

1840. Blanch., An. Art, iii. 464 [Lynmas]: Jarbus (Electron). Closely allied to Boisduval's species.

Doubleday, Westwood, Bates, Herrich-Schaeffer, Felder, and Kirby, have all since used it in the Boisduvalian sense. But as Chrysippus is generically distinct from Plexippus, Limnas will stand for the former.

636. Lincoya.

1871. Kirb., Syn. Cat., App. 649: **Pharsalia,** Felderi.

1873. Ib., Zoöl. Rec. for 1871, 360: specifies Pharsalia as type.

Correctly, as this was the type of Antigonis (q.v.), which Lincoya was intended to supplant.

637. Limochores.

1872. Scudd., Syst. Rev. 59: Mystic, bimacula, **Manataaqua,** Taumas, Arpa, Pilalka (Palatka), and a MS. species. **Manataaqua** is specified as type.

638. Liphyra.

1864. Westw., Proc. Ent. Soc. Lond. xxxi.: **Brassolis.** Sole species, and therefore type.

See Sterosis.

639. Liptena.*

1852? Westw., Gen. Diurn. Lep., pl. 77: Abraxas, Acræa.

1852. Ib., ib. 503: used as a synonyme of Pentila.

1865. Hewits., Exot. Butt. iii. 119: employs it for Acræa and others, so that Acræa becomes the type.

1868. Herr.-Schaeff., Prodr. iii. 13: follows Hewitson.

1871. Kirb., Syn. Cat. 335: follows Hewitson.

The name falls before Pentila and Tingra.

640. Loxura.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 119: *Atymnus*, Pita. Atymnus specified as type.

Since used in same sense by Boisduval, Duncan, and Westwood, but the name must fall before Myrina (q.v.).

641. Lucia.

1832–33. Swains., Zoöl. Ill. ii. 135: **Aurifer** (Limbaria). Sole species, and therefore type.

Since used by authors in the same sense.

642. Lucilla.

1870. Hewits., Equat. Lep. iv. 55: **Camissa.** Sole species, and therefore type.

643. Lucinia.

1822–26. Hübn., Exot. Schmett. ii.: **Sida.** Sole species, and therefore type.

Since used by Westwood, Felder, and Kirby, in same sense. See Autodea.

644. Lycæides.*

1816. Hübn., Verz. 69: *Argyrognomon* (Argus), Argus (Ægon), Optilete (Optilete, Cyparissus).

1850. Steph., Cat. Brit. Lep. 20, 261: employs it for Argus and other species not in Hübner's list. Argus therefore becomes the type.

1872. Scudd., Syst. Rev. 33: specifies Argus as the type.

The name falls before Rusticus. See also Scolitantides.

645. Lycæna.

1807. Fabr., Ill. Mag. vi. 285: I. Acis (Mars), Echion; II. Argiades, (Amyntas), rubi; III. Endymion (Meleager), Arion, Corydon, Thetis (Adonis), Leda (Ledi), virgaureæ, Phlæas.

1815. Oken, Lehrb. i. 717: restricts it mainly to the blues, referring to it all of the species indicated by Fabricius, excepting rubi and the coppers, virgaureæ and Phlæas, and adding others.

1816. Hübn., Verz. 23: employs it for Echerius (Xenodice), which has nothing to do with Fabricius's species.

1824. Curtis, Brit. Ent., pl. 12: designates Phlæas as type, but that is ruled out by Oken's action.

1828. Horsf., Descr. Cat. Lep. E. Ind. Co. 68: restricts it also to the coppers, but, for the same reason, erroneously.

1828. Steph., Ill. Brit. Ent. Haust. i. 79: does the same.

1832. Renn., Consp. 16: the same.

1832. Dup., Pap. France, Diurn. Suppl. 390: uses it for Bœticus and Telicanus, which belong elsewhere. See Polyommatus.

1832–33. Swains., Zoöl. Ill. 132: also designates Phlæas as the type.

1833. Boisd., Nouv. Ann. Mus. Hist. Nat. ii. 171: uses it for Bœticus, Telicanus, and others.

1836. Ib., Spec. gén., pl. 3 B.: gives a figure of Bœtica.

1837. Sodoffsk., Bull. Mosc. x. 81, 96: proposes to change the name to Lycia or Migonitis, preferably the latter.

1839. Ramb., Faune Ent. Andal. 262: restricts it again to the coppers, erroneously.

1840. Westw., Gen. Syn. 88: specifies Phlæas as type.

1847. Doubl., List Br. Mus. 40: employs it for a great number of species, including, of Fabricius's list, Argiades (Amyntas), Endymion (Meleager), Arion, Corydon, Thetis (Adonis).

1852. Westw., Gen. Diurn. Lep. 488: makes a similar but more extended use of it, in which he has been followed by most recent writers.

1871. Kirb., Syn. Cat. 340: restricts it again to the coppers.

1872. Scudd., Syst. Rev. 36: again specifies Phlæas as type.

No restriction of this group within the blues having been effected, the genus may be confined to Endymion and Corydon of the species mentioned by Fabricius, with Endymion for type. See Heodes.

646. Lycænesthes.

1865. Moore, Proc. Zoöl. Soc. Lond. 773: bengalensis Sole species, and therefore type.

647. Lycænopsis.

1865. Feld., Reise Novara, 257: **Ananga.** Sole species, and therefore type.

648. Lychnucus.

1825. Hübn., Zutr. iii. 24: **Olenus.** Sole species, and therefore type.

649. Lycia.*

1837. Sodoffsk., Bull. Mosc. x. 81: proposes this name to supplant Lycæna, for etymological reasons.

But these are insufficient, and Lycia is preoccupied in Lepidoptera (Hübn. 1816).

650. Lycorea.

1847 (July). Doubl., Gen. Diurn. Lep., pl. 16: **Cleobæa** (Atergatis). Sole species, and therefore type.

1847 (Aug.). Ib., ib. 105: Pasinuntia, Ceres, Halia, Cleobœa (Atergatis, Cleobæa).

This name is very close to Lycoris (Sav., Worms, 1817).

651. Lycus.*

1816. Hübn., Verz. 74: Niphon, *rubi*, Damon (Gryneus).

1850. Steph., Cat. Brit. Lep. 17: employs it for rubi only, which thereby becomes the type.

But the name is preoccupied in Coleoptera (Fabr. 1787).

652. Lymanopoda.

1851 (Jan.?) Westw., Gen. Diurn. Lep., pl. 67: **Samius.**

1851 (July). Westw., Gen. Diurn. Lep. 401: Samius, Ionius, obsoleta.

1865. Herr.-Schaeff., Prodr. i. 56: employs it for Samius and others not mentioned by Westwood.

1868. Butl., Ent. Monthl. Mag. iv. 196; and Cat. Sat. 168: designates Samius as the type.

See Sarromia.

653. Lyropteryx.

1851. Westw., Gen. Diurn. Lep. 433: **Apollonia,** Terpsichore.

Apollonia may be taken as the type.

654. Mancipium.

1806. Hübn., Tent. 1: **brassicæ.** Sole species, and therefore type.

1827. Steph., Ill. Brit. Ent. Haust. i. 22: employs it for Daplidice and cardamines, belonging to the same subfamily as Hübner's species.

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 141: uses it as a subdivision of Pontia, assigning to it three species which have intimate connection with the above.

1840. Westw., Gen. Syn. 87: specifies cardamines as type.

1852. Renn., Consp. 4: follows Stephens.

1850. Steph., Cat. Brit. Lep. 5: restricts it still further to Daplidice.

See also Ganoris, Pontia, and Pieris.

655. Maniola.

1801. Schrank, Fauna Boica, ii. i. 152, 170: I. Galathea (Galatæa), Ægeria, Megæra, Mæra, Dejanira, Medea, Ligea, Medusa, **Jurtina** (Lemur), Epiphron (Egea), Manto (Baucis), Hyperanthus, Arcania (Arcanius), Hero, Typhon (Tiphon), Pamphilus, Iphis (Manto), Semele, Phædra, Briseis (Briseis, Janthe), Hermione, Circe (Proserpina); II. Iris (Iris, Jole), Ilia (Julia, Ilia, Clytie).

1815. Oken, Lehrb. i. 732: employs it for Iris and Ilia.

1816. Hübn., Verz. 64: uses it for Afer (Phegea) and Phryne, both Satyrids, but neither of them specified by Schrank.

The former, however, is congeneric with those of Schrank's species, for which the name Erebia must be used by the earlier action of Dalman. Hence Hübner's action has no effect upon Schrank's genus.

1829. Meig., Eur. Schmett. i. 104: employs it for Briseis and very many others.

All his Satyrids are included, excepting those placed by him in Melanargia (Agapetes): comprising, among others, Jurtina, which may be taken as the type. Excluding the second section of Schrank's genus, which belongs to Potamis, there are no less than ten genera represented by the species enumerated in his list. Of these genera, one (Agapetes) was taken out by Billberg, in 1820; one (Erebia) by Dalman, in 1816; and one (Hipparchia), through the action of various writers, in 1820. Most of the others are taken up by Hübner's generic names, so that the choice finally lies between the present group represented by Jurtina, and that for which we have restricted Nytha (q. v.).

1859. Hein., Schmett. Deutschl. u. Schweiz, i. 26: Dejanira.

But this has belonged to Pararge from its foundation.

1871. Kirb., Syn. Cat. 57: considers it the same as Erebia.

656. Marica.*

1816. Hübn., Verz. 63: Stygne [also given by Hübner in the same work, in his genus Phorcis], Nelo.

The name falls before Erebia. See also Gorgo, Syngea, Phorcis, Epigea, and Oreina.

657. MARIUS.*

1832–33. Swains., Zoöl. Ill. ii. 45: *Chiron* (Cinna). Sole species, and therefore type.

1832–33. Ib., ib. ii. 59: Peleus (Thetys).

As the work was published in parts, Chiron was published before Peleus. Marius is one of the synonymes of Chiron; the generic name being based upon it falls. See also Euglyphus and Megalura.

658. MARMESSUS.

1816. Hübn., Verz. 81: Silenus (Alcides, Corax), Atymnus, **Lisias**.

Silenus and Atymnus belonging to the earlier Myrina, Lisias must be taken as the type of Marmessus.

659. MARPESIA.

1816. Hübn., Verz. 47: Thyonneus (Thyonnea), **Eleucha** (Eleuchea), Iole (Zosteria), Chiron (Chironias), Orsilochus (Cinna).

1844. Doubl., List Br. Mus. 86: employs it for Eleucha and Peleus (Thetis). Eleucha thereby becomes the type.

1850. Westw., Gen. Diurn. Lep. 263: uses it in the same way.

660. MECHANITIS.

1807. Fabr., Ill. Mag. vi. 284: Calliope, **Polymnia**, Erato (Doris), Psidii, Phyllis.

1866. Hübn., Verz. 11: uses it for Eucrate and Polymnia (Lysimnia, Polymnia). Polymnia therefore becomes the type.

1844. Doubl., List Br. Mus. 55: employs it for Polymnia (Lysimnia), and others.

1847. Ib., Gen. Diurn. Lep. 128: divides the eighteen species which he refers to this genus into two sections, placing Polymnia in the first.

1862. Bates, Linn. Trans. xxiii. 528: restricts the group to Doubleday's first section, dividing that again into two sections, of which Mechanitis proper is made to include "Polymnia and its allies."

See also Nereis.

661. MEGALURA.*

1840. Blanch., Hist. Ins. iii. 446: *Coresia*. Sole species, and therefore type.

1871. Kirb., Cat. 220: Coresia and many others.

The name is preoccupied through Megalurus (Vig.-Horsf., Birds, 1820; Agass., Fishes, 1833). See also Euglyphus and Marius.

662. Megamede.

1816. Hübn., Verz. 50: **Rhetenor** (Rhetenoris, Chalciope). Sole species, and therefore type.

663. Megastes.*

1851. Boisd. in Westw., Gen. Diurn. Lep. 346: given as a MS. synonyme of Dynastor (q. v.) by Westwood.

The species of Dynastor were Napoleon and Darius. Megastes, however, was only applied to Napoleon (Napoleo), and hence the name must fall before Dynastor.

1870. Boisd., Lép. Guat. 53: Macrosiris, Darius.

664. Megathymus.*

1872. Scudd., Syst. Rev. 62: *yuccæ*. Sole species and designated type.

It is not a butterfly.

665. Megistanis.

1844. [Boisd. in] Doubl., List Br. Mus. 109: Acheronta (Cadmus), **Bæotus** (Beotus).

1849. Boisd. in Doubl., Gen. Diurn. Lep., pl. 48: Bœotus (Beotus).

1850. Ib. in Westw., Gen. Diurn. Lep. 311: Bæotus (Beotus), Acheronta (Cadmus), and another.

By the publication of the plates of Doubleday and Westwood's Genera, Bæotus became the type, and in this sense it has been employed by Felder and Kirby. But Boisduval in 1870 (Lép. Guat.) refers Acheronta again to it. Kirby in his Synonymical Catalogue refers the genus to Westwood.

666. Megisto.

1816. Hübn., Verz. 54: Euritus (Cymelia), Argante, Canthus (Euridice), **Acmenis**.

1868. Butl., Cat. Sat. 14: specifies Eurytus as the type.

1872. Scudd., Syst. Rev. 6: does the same. But Eurytus is strictly congeneric with Penelope, the type of Cissia, and therefore Acmenis may be taken as the type of Megisto.

667. Megonostoma.*

1863. Reak., Proc. Ent. Soc. Phil. ii. 356: Cesonia (Cœsonia), Eurydice, Philippa, Helena.

1870. Butl., Cist. Ent. i. 36, 46: specifies Cesonia as the type.

1872. Kirb., Syn. Cat. 489 [Meganostoma]: Cesonia and allies.

The name must fall before Zerene, which, by the foundation of Eurymus, became restricted to this group.

668. Melampias.

1816. Hübn., Verz. 63: **Hyperbius** (Hyperbia), Mnestra, Epiphron (Rhodia, Janthe), Pharte, Arete.

1850. Steph., Cat. Brit. Lep. 9, 255: uses it for Epiphron (Cassiope), Melampus, and Mnestra.

1858. Kirb., List Brit. Rhop.: does the same.

But it cannot be used for these and their allies, as they are already taken up by Erebia, and consequently Hyperbius must be taken as the type. See Pseudonympha.

669. Melanargia.*

1829. Meig., Eur. Schmett. i. 97: Galathea (Leucomelas, Galathea, Procida, Electra, Galene), Lachesis, Russiæ (Clotho, Japygia), Arge (Simula), Thetis, Occitanica (Syllius).

1861. Staud., Cat. Lep. Eur. 9 [Melanagria]: refers the same and others to it.

1865. Herr.-Schaeff., Prodr. i. 58 [Melanagria]: the same.

A strictly homogeneous group, so that the name must fall before the earlier Agapetes. See also Arge.

670. Melania.*

1837. Sodoffsk., Bull. Mosc. x. 81: proposes to supplant Hipparchia by this word, but without sufficient reason; moreover, it is preoccupied in Mollusks (Sow. 1819).

671. Melanis.

1816. Hübn., Verz. 25: **Melander** (Melandra), Phereclus (Pherecla), Agyrtus (Agyrte).

Melander may be taken as the type. See Limnas.

672. Melanitis.

1807. Fabr., Ill. Mag. vi. 282: Leda, **undularis**.

1809. Latr., Gen. Crust. et Ins. iv. 197: Ariadne (Ariadne, Merione), undularis. The latter therefore is the type.

1828. Horsf., Cat. Lep. E. Ind. Co., expl. pl. 8: undularis only.

1833. Boisd., Ann. Mus. Hist. Nat. ii. 205: uses it for undularis and others.

1844. Doubl., List Br. Mus. 143: makes a similar use of it.

1851. Westw., Gen. Diurn. Lep. 403: uses it in the same manner.

1868. Butl., Ent. Monthl. Mag. iv. 194; Cat. Sat. 1: specifies Leda as the type, doubtless for the single reason that it is the first species mentioned by Fabricius, yet, as seen by the foregoing, erroneously.

1871. Kirb., Syn. Cat. 43: follows Butler.
1872. Ib., Trans. Ent. Soc. Lond. 1872, 115: specifies undularis as type.

673. MELANOCYMA.

1857. Westw., Trans. Ent. Soc. Lond. [N. S.] iv. 186: **Faunula.** Sole species, and therefore type.

674. MELETE.

1832–33. Swains., Zoöl. Ill. 79: **Lycimnia** (Limnobia). Sole species and designated type.

See Daptonoura.

675. MELINÆA.

1816. Hübn., Verz. 11: **Egina,** Clara, Equicola, Euniæ, Irene.
1837. Sodoffsk., Bull. Mosc. x. 80: ignorant of Hübner's use of it, proposes this name to supplant Melitæa.
1844. Doubl., List Br. Mus. 56: employs it for Egina and Clara of Hübner's species, besides others.

It has since been used in the same sense, and Egina may be taken as the type.

676. MELITÆA.*

1807. Fabr., Ill. Mag. vi. 284: Lucina, Didyma (Cinxia), Cynthia, Maturna.
1816. Dalm., Vetensk. Acad. Handl. xxxvii. 57: specifies Leucippe (Athalia) as type, but of course erroneously.
1832. Curt., Brit. Ent. pl. 386: designates Euphrosyne as type.
1837. Sodoffsk., Bull. Mosc. x. 80: proposes to change the name to Melinæa (q. v.).
1840. Westw., Gen. Syn. 88: specifies Cinxia as type.
1872. Crotch, Cist. Ent. i. 66: says that Leucippe (Athalia) is type, through Dalman.

The name, however, falls, because preoccupied through Melitea (Pér.-Les., Acal. 1809). See Lemonias.

677. MELLICTA.*

1820. Billb., Enum. Ins. 77: Maturna, Aurinia (Artemis), Cinxia, Didyma, Dictynna, Athalia, Parthenie, Lucina, and some MS. species.

This name falls before the earlier Lemonias, Schoenis, and Cinclidia.

678. MEMPHIS.

1816. Hübn., Verz. 48: **Polycarmes** (Odilia), Basilia.

Polycarmes may be taken as type.

679. MENELAIDES.

1816. Hübn., Verz. 84: Hector, **Polytes** (Romulus), **Demetrias,** Theseus, Aristolochiæ (Polydorus), Polytes, Alphenor, Ascanius, Agavus.

Polytes may be taken as the type.

680. MENERIS.

1844. [Boisd. in] Doubl., List Br. Mus. 106: **Tulbaghia.** Sole species, and therefore type.

1849. Boisd. in Doubl., Gen. Diurn. Lep., pl. 46: the same.

1850. Boisd. in Westw., ib. 296: the same.

It has since been used in the same sense. See Æropetes.

681. MESAPIA.

1856. Gray, List Lep. Brit. Mus. 92: **Peloria.** Sole species, and therefore type.

1872. Kirb., Syn. Cat. 510: the same.

The name is very near to Mesapus (Raf., Crust. 1814).

682. MESENE.

1847. Doubl., List Br. Mus. 7: **Phareus,** Thelephus (Telephus), and MS. species.

1851. Westw., Gen. Diurn. Lep. 441: Phareus (Pharea), Thelephus (Telephus), and others.

1867. Bates, Journ. Linn. Soc. Lond. ix. 439: employs it for Doubleday's species and many others.

1871. Kirb., Syn. Cat. 315: Doubleday's species and others.

Phareus may be taken as the type. See Hübner's use of Emesis.

683. MESOPHTHALMA.

1851. Westw., Gen. Diurn. Lep. 455: **Idotea** (Idotæa). Sole species, and therefore type.

684. MESOSEMIA.

1816. Hübn., Verz. 21: Philemon (Icare), Hyphæa (Hiphia), **Philocles** (Philoclessa), Cœa, Ulrica (Ultio), Osinia, Eumene, Crœsus (Capanea), Ephyne, Thymetus (Thymete), Rosina.

1847. Doubl., List Br. Mus. 12: employs it for Philemon, Philocles, Crœsus (Capanea), and a number of unpublished species.

1851. Westw., Gen. Diurn. Lep. 453: uses it for Philocles, and other species not given by both Hübner and Doubleday. This, therefore, becomes the type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 416: employs it for many species, including Philocles.

1871. Kirb., Syn. Cat. 288: follows Bates.

685. Mesotænia.

1871. Kirb., Syn. Cat. 209: **Doris**. Sole species, and therefore type.

Employed in place of Callitænia, preoccupied; but it is itself very close to Mesotena (Eschsch., Col. 1831).

686. Messaras.*

1848. Doubl., Gen. Diurn. Lep. 163: *Erymanthis*, Alcippe.

Subsequently used by Felder and Kirby, the latter for Erymanthis only and its allies. But this name must fall, whichever species is chosen as type. See Atella and Cupha.

687. Mestra.

1822–26. Hübn., Exot. Schmett. ii.: **Hypermnestra** (Hypermestra). Sole species, and therefore type. See also Cystineura.

688. Metacharis.

1867. Butl., Ent. Monthl. Mag. iii. 174: **Ptolomæus**, Agrius, Cadmeis, regalis, Lucius (Batesii). The first three specified as types.

1868. Bates, Journ. Linn. Soc. Lond. ix. 444: places nine species here, including Ptolomæus and Agrius and other of Bates's species, but excluding Cadmeis, which is placed under Charis.

1871. Kirb., Syn. Cat. 320: uses it in the same way as Bates.

Ptolomæus may be taken as the type.

689. Metamorpha.

1816. Hübn., Verz. 43: **Sulpitia** (Elissa), Steneles (Sthenele), Dido.

Dido belongs to Colænis, and Sulpitia may be taken as the type of this group, since it is generically distinct from Steneles, the type of Victorina.

690. Metapheles.

1866. Bates, Ent. Monthl. Mag. iii. 155: **Dinora**. Sole species, and therefore type.

Used for same species by Bates and Kirby.

691. Metaporia.

1870. Butl., Cist. Ent. i. 38, 51: **Agathon**. Sole species and designated type.

692. METHONA.*

1847 (Oct.). Doubl., Gen. Diurn. Lep. 115: *Themisto.* Sole species, and therefore type.

Subsequently used by Bates and Herrich-Schaeffer in same sense; but the name must fall before Thyridia, limited at the same time to same group by Doubleday himself. Doubleday also, in the same year, established a genus Methone for an entirely different insect.

693. METHONE.*

1847. Doubl., List Br. Mus. 4: *Cecilia* (Cæcilia). Sole species, and therefore type.

1851. Westw., Gen. Diurn. Lep. 422: the same. See also Table vi. and 533.

Westwood changes this name to Methonella (q. v.) because preoccupied by Methona, q. v. (Doubl., Lep. 1847), but both bear the same date. If Methona was first published, of course this falls, and Bates and Kirby assume this.

694. METHONELLA.

1852. Westw., Gen. Diurn. Lep. Table vi. and 533: **Cecilia.** Sole species, and therefore type.

Subsequently used in same way by Bates and Kirby. See Methone.

695. METURA.

1873. Butl., Lep. Exot. 155: Rurina, irrigata, intermedia, Virgo, **Cipris** (bracheolata, Neocypris).

Cipris may be taken as the type. Is the name too near Mitoura?

696. MICROTIA.

1864–65. Bates, Ent. Monthl. Mag. i. 83: **Elva.** Sole species, and therefore type.

This name is very close to Microtus (Schrank, Mam. 1789).

697. MIDEA.*

1867. Herr.-Schaeff., Prodr. ii. 16: *Genutia.* Sole species, and therefore type.

Used also by Kirby; but the name is founded on one of the synonymes of Genutia, and therefore falls. See Anthocharis.

698. MIGONITIS.

1816. Hübn., Verz. 12: Thales, Aœde, **Erato** (Erato, Crenis), Burneyi, Thelxiope, Melpomene (Andremone, Ulrica, Erythræa), Egeria (Isæa).

1837. Sodoffsk., Bull. Mosc. x. 82: probably ignorant of Hübner's use of this word, proposes to substitute it for Lycæna.

Erato may be taken as the type. See also Crenis and Laparus.

699. MILETUS.

1816. Hübn., Verz. 71: **Polycletus** (Epopus, Polycletus), Symethus.
1852. Westw., Gen. Diurn. Lep. 502: employs it for Symethus and three others.
1857. Horsf.-Moore, Cat. Lep. E. Ind. Co.: make a similar use of it.
1871. Kirb., Syn. Cat. 337: the same.

Symethus would therefore be type; but Boisduval had already selected this as type of Gerydus (q. v.), and therefore Polycletus must be type. See also Symetha.

700. MIMACRÆA.

1872. Butl., Lep. Exot. i. 104: **Darwinia.** Sole species, and therefore type.

701. MIMONIADES.

1823. Hübn., Zutr. ii. 27: **Iphinous** (Ocyalus). Sole species, and therefore type.

702. MINETRA.*

1832. Boisd., Voy. Astrol. 126: Nodrica, *sylvia.*
1844. Doubl., List Br. Mus. 86: uses it for sylvia, Gambrisius. Sylvia therefore becomes type.

Since used for all these species by Westwood and Felder. The name falls before Parthenos (q. v.).

703. MINOIS.

1816. Hübn., Verz. 57: **Phædra,** Alcyone, Hermione, Circe (Proserpina), Persephone (Anthe), Briseis, Merope (Œnomais.)
1850. Steph., Cat. Brit. Lep. 254: employs it for Briseis, Phædra, and Hermione.
1858. Kirb., List Brit. Rhop.: uses it for Phædra only, which therefore becomes type.
1867. Butl., Ent. Monthl. Mag. iii. 279: employs it for Phædra (Dryas) and others.
1868. Ib., ib. iv. 194; and Cat. Sat. 61: designates Phædra (Dryas) as type.
1872. Scudd., Syst. Rev. 5: does the same.

704. Mithras.

1816. Hübn., Verz. 79: **Nautes** (Nautus), Elis, Meton (Metus), Apidanus (Apidanus, Dorimund).

1869. Butl., Cat. Fabr. Lep. 195: employs it for Pholeus and others, none of which are mentioned by Hübner, although allied to all but the last.

In accordance with Butler's usage, Nautes may be taken as the type. See Molus.

705. Mitocerus.*

1820. Billb., Enum. Ins. 79: *Phidippus*. Sole species, and therefore type.

The name falls before Amathusia.

706. Mitoura.

1872. Scudd. Syst. Rev. 31: **Damon** (smilacis). Sole species, and therefore type.

1874. Rye, Zoöl. Rec. for 1872, 350: suggests spelling it Mitura.

It is derived from *μίτος* and *οὐρά*.

707. Mœra.*

1816. Hübn., Verz. 51: Aurelius (Aurelia), Phidippus (Phidippe), Adonis (Adonidis) Tullia, Celinde, Automedon (Automedæna).

The name is preoccupied in Crustacea (Leach, 1815).

708. Molus.

1816. Hübn., Verz. 78: **Phalanthus** (Phalantus), Ismarus.

Philanthus may be taken as the type. Will it fall before Mithras?

709. Monethe.

1851. Westw., Gen. Diurn. Lep. 461: **Alphonsus**. Sole species, and therefore type.

Used in same sense by Bates and Kirby.

710. Moritzia.*

1861. Feld., Wien. Ent. Monatschr. v. 100: *noctula* (**paradoxa**). Sole species, and therefore type.

The name falls before Hades.

711. Morpheis.*

1827–37. Gey. in Hübn., Exot. Schmett. iii: *Ehrenbergii.* Sole species, and therefore type.

Used for same species only, by Doubleday, Westwood, and Felder; but the name is preoccupied in Lepidoptera (Hübn. 1816). See Anemeca.

712. Morpho.

1807. Fabr., Ill. Mag. vi. 280: **Achilles**, Menelaus, Hecuba.
1815. Oken, Lehrb. i. 733: employs it for Sibylla, Camilla, and populi!
1816. Hübn., Verz. 49: employs it for species of Prepona only.
1820. Oken, Lehrb. f. Schulen, 791: the Fabrician species and others.
1836. Boisd., Spec. gén., pl. 8 B.: employs it for Cytheris, a species allied to the Fabrician.
1844. Doubl., List Br. Mus. 115: uses it for all the species of Fabricius and others.
1851. Westw., Gen. Diurn. Lep. 337: the same. On p. 341 Achilles is specified as the type.
1872. Crotch, Cist. Ent. i. 65: specifies Achilles as the type.

713. Moschoneura.

1870. Butl., Cist. Ent. i. 39, 54: **Methymna**, Pinthæus (Pinthœus), Nehemia (Cydno). Methymna specified as type.

714. Murtia.

1816. Hübn., Verz. 98: **Pyranthe** (Minna). Sole species, and therefore type.

715. Mycalesis.

1816. Hübn., Verz. 55: **Evadne**, Mineus (Minea, Justina), Mamerta (Hamerta), Medus (Hesione), Ostrea (Otrea).
1844. Doubl., List Br. Mus. 139: employs it for Medus (Hesione), Mineus, Ostrea (Otrea), and some MS. species.
1851. Westw., Gen. Diurn. Lep. 392: the same and others.
1865. Herr.-Schaeff., Prodr. i. 62: the same.
1868. Butl., Cat. Sat. 128: specifies Evadne as type.
1871. Kirb., Syn. Cat. 87: Evadne, Medus, Mineus, Ostrea, and others.

Evadne may be accepted as the type, one at least of the species placed in this group by Doubleday being strictly congeneric therewith. See Orsotriæna.

716. Mylothris.

1816. Hübn., Verz. 90: **Rhodope** (Arsalte), Ilaire (Margarita), Argia, Lyncida (Monuste, Hippo), Hedyle, Drusilla, Lycimnia (Agrippina), Demophile, Monuste (Hippomonuste).

1850. Steph., Cat. Brit. Lep. 254 [Milothris]: employs it for Monuste only.

1870. Butl., Cist. Ent. i. 34, 42: employs it for Rhodope (Poppea, Rhodope), Agathina, and Trimenia, and specifies Rhodope (Poppea) as type.

It cannot be used for Monuste in accordance with Stephens's usage, since that must be the type of Ascia (q. v.).

717. Mynes.

1832. Boisd., Voy. Astrol. 129: Australis (Leucis), **Geoffroyi.**

1848. Doubl., List Br. Mus. App. 22: employs it for Geoffroyi and others, and therefore this becomes type.

1850. Westw., Gen. Diurn. Lep. 267: follows Boisduval.

1869. Wall., Trans Ent. Soc. Lond. 77: considers Geoffroyi as the type and describes two others.

1871. Kirb., Syn. Cat. 274: follows Wallace.

718. Myrina.

1807. Fabr., Ill. Mag. vi. 286: **Silenus** (Alcides), Helius (Heleus).

1815. Oken, Lehrb. i. 722: uses it for eight species, specifying only Silenus (Alcides) and Halesus.

1823. God., Encyl. méth. 592: divides the group into two sections, omitting Helius and placing Silenus (Alcides) in the second.

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 116: employs it for Ravindra and Freja (Jafra), and specifies the latter as the type, erroneously.

1836. Boisd., Spec. gén., pl. 3 B, 6 C.: uses it for the Horsfieldian species and another.

1847. Doubl., List Br. Mus. 21: the same and others.

1852. Westw., Gen. Diurn. Lep. 475: employs it for eighteen species, including Freja and Silenus (Alcides).

1870. Kirb., Journ. Linn. Soc. Lond. x. 500: specifies Silenus (Alcides) as type.

1872. Crotch, Cist. Ent. i. 66: says Silenus (Alcides) is type, through Westwood, 1852.

But it was determined long before that; for Helius was taken in 1816 as type of Iolaus, and nothing but Silenus then remained. See also Loxura.

719. Myscelia.*

1844. [Boisd. in] Doubl., List Br. Mus. 88: Orsis, Numilia (Mycalia), Acontius (Medea).

1849. Boisd. in ib., Gen. Diurn. Lep. 220: employs it for Orsis, Cyaniris, Ethusa, and Antholia.

1861. Feld., Neues Lep. 16: I. Orsis; II. Ethusa, Cyaniris.

1870. Boisd., Lép. Guat. 40: claims it as his own, and says it was founded on the females of Epicalia, and so should be dropped.

The name, too, is unfortunately near Miselia (Ochs., Lep. 1816), and is actually preoccupied through Myscelus (Hübn., Lep. 1816; Heyd., Arachn., 1826). See Sagaritis.

720. Myscelus.

1816. Hübn., Verz. 110: **nobilis**, Sebaldus, Erythus.

1852. Westw., Gen. Diurn. Lep. 526: the same and others.

1869. Herr.-Schaeff., Prodr. iii. 58: uses it for a large number of species, including nobilis and Assaricus.

1869. Butl., Cat. Fabr. Lep. 264: employs it for nobilis and Assaricus.

1870. Butl., Ent. Monthl. Mag. vii. 92: specifies nobilis as the type.

1871. Kirb., Syn. Cat. 587: uses it in the same sense.

721. Nahida.

1871. Kirb., Syn. Cat. App. 651: **cœnoides.** Sole species, and therefore type.

Employed to replace Threnodes preoccupied.

722. Nais.*

1832–33. Swains., Zoöl. Ill. ii. 136: *Thysbe* (splendens). Sole species, and therefore type.

Subsequently used by Felder. But one of the synonymes of Thysbe is Nais, and the name therefore falls; it is also preoccupied in Worms (Mull. 1771).

723. NAJAS.

1806. Hübn., Tent. 1: **populi.** Sole species, and therefore type.

See Nymphalis and Limenitis. See also Nympha, p. 223.

724. NAPÆA.

1825. Hübn., Catal. Franck, 76: Nicæus (Nicæa), Halimede, Eucharila (Actoria), Thersander, Lucinda, Mandana (Mandane), Lucina, Ceneus (Lusca), Athemon (Athemæna), Lamis, Caricæ, Mantus (Mante), Bomilcar (Bombilcar), Phareus (Pharea), Thisbe (Perdita), Pais, Dorilas (Nyx), **Lisias** (Lisiassa), Sagaris.

Lisias may be taken as the type.

725. NAPEOCLES.

1864. Bates, Journ. Ent. ii. 194: **jucunda.** Sole species, and therefore type.

1872. Kirb., Syn. Cat. 193: the same.

726. NAPEOGENES.

1862. Bates, Linn. Trans. xxiii. 533: I. **Cyrianassa** (Cyrianassa, Tunantina, Adelphe), Inachia (Inachia, Pyrois, Pharo, Ercilla, sulphurina), Ithra, Corena; II. Pheranthes, Crocodes, Duressa. Besides these, not classed in either group, are Tolosa, Larina, Apulia, and Xanthare.

1871. Kirb., Syn. Cat. 24: uses it in the same sense.

Cyrianassa may be taken as the type.

727. NAROPE.

1849. Boisd. in Doubl., Gen. Diurn. Lep., pl. 50: **Cyllastros.** Sole species, and therefore type.

1851. Boisd. in Westw., Gen. Diurn. Lep. 348: Cyllastros and two others.

Used in same sense by Herrich-Schaeffer and Kirby.

728. NATHALIS.

1836. Boisd., Spec. gén. 589: **Iole.** Sole species, and therefore type, as stated by Butler.

Since used in same sense.

729. NECTARIA.

1820. Dalm. in Billb., Enum. Ins. 76: given by Billberg as the equivalent of Fabricius's Idea, which fell, from being founded on the single species **Idea,** which therefore becomes the type of this genus.

See Idea and Hestia.

742. NEREIS.*

1806. Hübn., Tent. 1: *Polymnia.* Sole species, and therefore type.

The name is preoccupied in Worms (Linn. 1781). See Mechanitis.

743. NERIAS.

1836. Boisd., Spec. gén., pl. 4 A., 7 B.: Calliope, Euterpe, **Susanna.** The larva and pupa only of the first two are figured.

1844. Doubl., List Br. Mus. 64: employs it for Phlegia and Susanna only.

Susanna, therefore, becomes the type. The name is very near to Neria (Rob.-Desv., Dipt. 1830).

744. NESSÆA.*

1816. Hübn., Verz. 41: Obrinus (Ancæa), Harpalyoe, Galanthis.

This name is preoccupied through Nesæa (Lamx., Pol. 1812).

745. NESTORIDES.

1816. Hübn., Verz. 86: **Gambrisius** (Drusius, Gambrisius, Amphitrion). Sole species, and therefore type.

746. NETROCORYNE.

1867. Feld., Reise Novara, 507: **repanda.** Sole species, and therefore type, as stated by Butler.

1867. Hewits., Hundr. Hesp. 22: beata, Denitza.

1869. Herr.-Schaeff., Prodr. iii. 69: repanda, cœcutiens.

1871. Kirb., Syn. Cat. 621: all the above.

747. NEUROSIGMA.

1868. Butl., Proc. Zoöl. Soc. Lond. 615. **Siva** specified as type.

1871. Kirb., Syn. Cat. 249: the same.

See Acontia.

748. NICA.*

1822–26. Hübn., Exot. Schmett. ii.: *flavilla.* Sole species, and therefore type.

Since used in the same sense by Doubleday, Felder, and Kirby; but the name is preoccupied through Nika (Risso, Crust. 1816).

749. NICONIADES.

1816–21. Hübn., Exot. Schmett. ii.: **Xanthaphes** (Xanthaptes). Sole species, and therefore type.

1821. Ib., Index, 7: the same.

This name is too close to Nisoniades of the same family, proposed by the same author (Verz. 1816), to stand. It cannot, however, have been a simple typographical error. See Gonilobа.

750. Nina.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 140: *Xiphia* (Nina). Sole species, and therefore type.

The name is one of the synonymes of Xiphia, and therefore falls. See Leptosia and Nychitona.

751. Nirodia.

1851. Westw., Gen. Diurn. Lep. 430: **Belphegor.** Sole species, and therefore type.

752. Nisoniades.

1816. Hübn., Verz. 108: **Bromius**, Mimas, Zephodes, Juvenalis (Juvenis), Tages, Flesus (Ophion), and a MS. species.

1850. Steph., Cat. Brit. Lep. 22: restricts the name to Tages, but this had already (1832) been taken to form Thanaos.

1852. Westw., Gen. Diurn. Lep. 579: employs it for all of Hübner's species excepting Zephodes and Flesus, and for many others.

1869. Butl., Cat. Fabr. Lep. 286: employs it for Tages, Juvenalis, Mimas, and others.

1871. Staud., Cat. Eur. Lep. 34: uses it for Tages and others.

Other authors have used it similarly. Bromius may be taken as the type. See Thanaos.

753. Nomiades.

1816. Hübn., Verz. 67: **Semiargus** (Acis), Atys (Pheretes), Damon, Cyllarus (Damœtas), Arcas (Erebus), Alsus, Alcon, Diomedes (Euphemus), Arion, Lysimon.

1850. Steph., Cat. Brit. Lep. 19, 261: employs the name for Alsus, Semiargus (Acis), Arion, and Alcon.

1858. Kirb., List Brit. Rhop.: uses it for the same, excepting Alsus, and for others. The query attached to many of them only indicates that they are doubtful as British species.

Semiargus may be taken as the type.

754. Notheme.

1851. Westw., Gen. Diurn. Lep. 462: **Eumeus** (Ouranus). Sole species, and therefore type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 425: the same and another.

See Amblygonia.

755. NYCHITONA.*

1870. Butl., Cist. Ent. i. 34, 41: *Alcesta* (Dorothea), Xiphia (Niobe). The former specified as type.

The name falls before Leptosia. See also Nina.

756. NYMPHALIS.

1805. Latr., Sonn. Buff. xiv. 82: (*nymphales*) Jason (Jasius), Antiopa, Polychloros, vau. album (v. album), urticæ, c. album, Egea (triangulum), Levana (Prorsa, Levana), Atalanta, Io, cardui, celtis, populi, Sappho (Lucilla), Sibylla (Sibilla), Iris (Iris, Beroe); (*perlati*) Paphia (Paphia, Valesiana), Adippe, Aglaia, Daphne, Dia, Pales, Euphrosyne (Euphrosine), Lathonia, Lucina, Cynthia, Aurinia (Artemis), Cinxia; (*satyri*), Circe, Hermione, Briseis, Fidia, Statilimus (Fauna), Actæa, Semele, Phædra, Ligea, Melampus, Manto (Pollux), Medea (Æthiops), Dejanira, Ægeria, Mœra (Satyrus), Hyperanthus, Tithonus (pilosellæ), Jurtina (Janira), Pamphilus, Arcania (Arcanius), Galathea.

As Latreille indicates the first of these groups as typical by giving it the distinctive name *nymphales*, any further restriction of the genus must be confined to this group.

1810. Ib., Consid. 440: Dido, aceris, populi, and Achilles are specified as types.

Populi is the only one given in the previous list, none of the others being even congeneric with any of the species then referred to the genus. This, therefore, would become the type, had it not been previously taken as the type of Najas (q. v.). Latreille's treatment of the group in his Genera (1809), and in Cuvier's Règne Animal (1817), is essentially the same as in Sonnini's Buffon.

1816. Lam., Hist. Nat. An. sans Vert. iv. 24: employs it for the Satyrids only, but of course erroneously.

1823. God., Tab. Meth. 43: uses it for Jason (Jasius), Iris, Ilia, populi, Sibylla, Camilla, Sappho (Lucilla).

Jason had already been taken as the type of Charaxes, as Felder has pointed out; Iris, and consequently Ilia, were removed to Potamis in 1806. Camilla became the type of Limenitis in 1815, taking with it Sibylla; so that Sappho must be considered the type of this genus.

1828. Boit., Man. Ent. ii. [Nymphalus].

1829. Boisd., Index, 16: restricts it to populi.

1832. Dup., Pap. France, Diurn. Suppl. 401: the same.

1833. Brullé, Exp. Morée, 283: uses it for Jason (Jasius) only.

1844. Doubl., List Br. Mus. 96: employs it for populi, Artemis, etc.
1850. Westw., Gen. Diurn. Lep. 306: considers Jason as type.
1861. Feld., Neues Lep. 41: divides the group into four sections, including the genera Cymatogramma and Paphia of Doubleday's Genera, but mentions no species referred to the group by Latreille. See remarks in his note.
1871. Kirb., Syn. Cat. 267; uses it for Jason and allies; but on p. 648 makes it supplant Vanessa, and refers the genus to Linné.
1872. Crotch, Cist. Ent. i. 60: also wrongly refers the genus to Linné [Nymphales], and says that Lamarck in 1801 (where only the plural form is used) fixed the type as Atalanta.
1872. Scudd., Syst. Rev. 10: specifies Polychloros as type, erroneously. See also Neptis and Limenitis.

757. Nymphidium.

1807. Fabr., Ill. Mag. vi. 286: Caricæ, **Thelephus** (Telephus), Athemon.
1815. Oken, Lehrb. i. 722: the same and others.
1832. Boisd.-LeC., Lép. Am. Sept. 130 [Nymphidia]: Cæneus (Pumila).
1836. Boisd., Spec. gén., pl. 2 B.: Jessa.
1847. Doubl., List Br. Mus. 10: employs it for a large number, including, of Fabricius's species, only Caricæ.
1851. Westw., Gen. Diurn. Lep. 447: employs it for twenty species, including Caricæ and Lamis, which are specified as "representative."
1868. Bates, Journ. Linn. Soc. Lond. ix. 450: uses it for nearly fifty species, including Caricæ.
1872. Crotch, Cist. Ent. i. 66: says that Caricæ is type, through Westwood in 1850 [1851].

Caricæ, however, belongs to Peplia, 1816, and Athemon to another family. Hence Thelephus should be taken as the type. See Peplia, Desmozona, and Heliochlæna.

758. Nymula.

1836. Boisd., Spec. gén., pl. 4 C.: **Gnosia**. Sole species, and therefore type.
1840. Blanch., Hist. Nat. Ins. iii. 465 [Nimula].
1868. Bates, Journ. Linn. Soc. Lond. ix. 450: employs it for Gnosis and allies.

759. NYTHA.

1820. Billb., Enum. Ins. 77: Hyperbius, Medea, Clytus, Mæra, Agave (Alcyone, Hippolyte), Semele, **Hermione**, Briseis, Statilimus (Faunus), Fidia, and several MS. Species.

All these species, excepting Hermione and Briseis, fall into the genera Erebia, Eumenis, Pararge, Melampias, and Dira; all of which are of earlier date. The name may therefore be retained for these two species and their allies, with Hermione for type. See also Maniola and Oreas.

760. OARISMA.

1872. Scudd., Syst. Rev. 54: **Poweshiek**. Sole species and designated type.

761. OCALIS.*

1851. Boisd. in Westw., Gen. Diurn. Lep. 371: Westwood gives it as a MS. synonyme of Oressinoma (q. v.).

1870. Boisd., Lép. Guat. 63: *Typhla*. Sole species, and therefore type.

This name falls before Oressinoma; and is besides too close to Ocalea (Erichs., Col. 1837).

762. OCHLODES.

1872. Scudd., Syst. Rev. 57: **nemorum**, agricola, Sonora. Nemorum specified as type.

763. OCYTES.

1872. Scudd., Syst. Rev. 55: **Metea**, Seminole. Metea specified as type.

764. ŒNEIS.

1816. Hübn., Verz. 58: **Norna** (Norna, Celæno), Polixenes (Bore), Jutta, Arethusa.

1868. Butl., Ent. Monthl. Mag. iv. 196; Cat. Sat. 160: specifies Norna as the type.

1871. Staud., Cat. 27: uses it in the same sense.

1871. Kirb., Syn. Cat. 68: the same.

1872. Scudd., Syst. Rev. 4: specifies Norna as type.

See also Chionobas.

765. ŒNOMAUS.

1816. Hübn., Verz. 76: Marsyas, **Ortygnus**, Eumolphus, Rustan, Palegon.

1869. Butl., Cat. Fabr. Lep. 196: employs it for Marsyas.

But this is already the type of Pseudolycæna. Ortygnus may be chosen as the type.

766. Ogyris.

1847. Doubl., List Br. Mus. 20: Idmo, **Abrota**, Damo (all inedited).

1852. Westw., Gen. Diurn. Lep. 472: Abrota, Idmo: the former is figured.

1871. Kirb., Syn. Cat. 425: Abrota, Idmo, and others.

Since Doubleday's genus was undescribed, and at the time when it was proposed all the species were inedited, the genus can only date from 1852, though it should bear Doubleday's name: at this time the only published species was Abrota, and this therefore must be the type. Idmo was not published until 1862, and Damo is still a MS. name.

767. Oileides.

1822–26. Hübn., Exot. Schmett. ii.: Vulpinus, **Zephodes**.

Zephodes may be taken as the type.

768. Oleria.

1816. Hübn., Verz. 9: **Astrea**, Flora, Aegle (Clio).

1862. Bates, Linn. Trans. xxiii. 529: Phyllodoce, Theaphia: these species are allied to Hübner's, but have no immediate connection with them. See Scada.

1864. Herr.-Schaeff., Prodr. i. 47: follows Bates.

Astræa may be taken as the type.

769. Oligoria.

1872. Scudd., Syst. Rev. 61: **maculata**. Sole species and designated type.

Is this name too close to Oligorus (Dej., Col. 1838)?

770. Olina.*

1848. Doubl., Gen. Diurn. Lep., pl. 31: *Azeca*. Sole species, and therefore type.

1851. Westw., Gen. Diurn. Lep. 407: Azeca, Emilia.

The name is preoccupied in Diptera (Rob.-Desv. 1830). See Vila.

771. Olynthus.

1816. Hübn., Verz. 80: Inachus, **Narbal**.

Narbal may be taken as the type.

772. Olyras.*

1847. Doubl., Gen. Diurn. Lep. 107: *Crathis*. Sole species, and therefore type.

Used in same sense by Herrich-Schaeffer and Kirby, but the name is preoccupied through Olyra (McClell., Fishes, 1842), and perhaps through Oluris (Heyd., Arachn. 1826).

773. Opsiphanes.

1849. Doubl., Gen. Diurn. Lep., pl. 57: Boisduvalii, **Sallei**, Reevesii.

1851. Westw., Gen. Diurn. Lep. 344: Syme and eleven others, including Boisduvalii, Sallei, Xanthus, and Berecynthus, but not Reevesii. Xanthus and Berecynthus are specified as types, but they cannot be, because they were not of the original species.

1864. Herr.-Schaeff., Prodr. i. 54: Berecynthus and others.

1871. Kirb., Syn. Cat. 125: all the above but Reevesii.

Sallei may be taken as the type.

774. Oreas.*

1806. Hübn., Tent. 1: *Circe* (Proserpina). Sole species, and therefore type.

1815. Oken, Lehrb. i. 740: the same and others.

1865. Feld., Reise Novara, 305: Marathon, Ctesiphon: wholly unrelated to the above. See Rusalkia.

1867. Bates, Journ. Linn. Soc. Lond. ix. 431: follows Felder.

The name is preoccupied in Mammals (Desm. 1804). See Nytha.

775. Oreina.*

1840. Westw., Brit. Butt. 76: Ligea, Medea (Blandina), *Epiphron* (Cassiope).

1867. Butl., Ent. iii. 277: Epiphron and others not in preceding list.

1868. Ib., Ent. Monthl. Mag. iv. 194: specifies Epiphron (Cassiope) as type.

The name is preoccupied in Coleoptera (Chevr. 1834). See Erebia, Gorgo, Marica, Syngea, Phorcis, and Epigea.

776. Oressinoma.

1850. Westw., Gen. Diurn. Lep., pl. 62: **Typhla**. Sole species, and therefore type, as stated by Butler.

1851. Ib., ib. 371: the same.

See Ocalis.

777. Orestias.*

1862. Feld., Wien. Ent. Monatschr. vi. 73: *Vitula*. Sole species, and therefore type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 432 [Orestia]: the same and another.

1868. Herr.-Schaeff., Prodr. iii. 7 [Orestia]: follows Bates.

The name is preoccupied in Fishes (Val. 1839) and also through Orestia in Coleoptera (Chevr. 1834). See Cartea.

778. Orimba.

1856. Boisd. in Herr.-Schaeff., Exot. Schmett. 55: **Cepha** (Cataleuca), Pasiphae (Arcas).

Pasiphae was taken in 1847 as the type of Pandemos, so that Cepha must be taken as the type of this genus. See Aricoris, in founding which Boisduval also made use of Cepha!

779. Orinoma.

1846. Doubl., in Gray's Nepaul, 14: **Damaris**. Sole species, and therefore type, as stated by Butler.

Used for this species only by Westwood, Herrich-Schaeffer, Butler, and Kirby.

780. Ornithoptera.

1832. Boisd., Voy. Astrol. 33: **Priamus**, Helena (Amphimedon, Helena).

1836. Ib., Spec. gén. 173: Priamus, Helena, and others.

Used in same sense by Doubleday and Westwood. Priamus may be taken as the type.

781. Orpheides.

1816. Hübn., Verz. 86: **Demoleus**, Erithonius (Epius).

Demoleus may be taken as the type.

782. Orsotriæna.*

1858. Wallengr., K. Vet. Akad. Förh. xv. 79: *Medus* (Hesione). Sole species, and therefore type.

The name probably falls before Mycalesis.

783. Oxeoschistus.

1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 268: **Puerta**, Hilara, Protogenia, Pronax, Propylea, Prochyta, Irmina, Tauropolis. Puerta specified as type.

1868. Ib., Cat. Sat. 180: the same.

1871. Kirb., Syn. Cat. 106: follows Butler.

784. Oxylides.

1816. Hübn., Verz. 77: Celmus, **Faunus**.

Faunus may be taken as the type.

785. OXYNETRA.

1862. Feld., Wien. Ent. Monatschr. vi. 179: **semihyalina.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 583: the same.

786. PACHLIOPTERA.

1864. Reak., Proc. Ent. Soc. Phil. iii. 503: Darsius, Pompeus, Rhadamanthus, Priamus, Hector, **Aristolochiæ** (Diphilus), Philenor? Polydamus? Clytia (dissimilis).

Aristolochiæ may be taken as the type. See also Polydorus.

787. PACHYRHOPALA.*

1858. Wallengr., K. Vet. Akad. Förh. xv. 81: *Phidias.* Sole species, and therefore type.

The name falls before Tamyris.

788. PACHYTHONE.

1867. Bates, Journ. Linn. Soc. Lond. ix. 389: **Erebia,** Lateritia, distigma, Xanthe, mimula.

1871. Kirb., Syn. Cat. 316: the same.

Erebia may be taken as the type.

789. PAGYRIS.*

1870. Boisd., Lép. Guat. 34: *Ulla.* Sole species, and therefore type.

Preoccupied through Pagurus (Fabr., Crust. 1798).

790. PALÆONTINA* (fossil).

1873. Butl., Lep. Exot. i. 126: *oolitica.* Sole species, and therefore type.

It is not a butterfly, as I shall show in my memoir on Fossil Butterflies, shortly to be published by the Amer. Assoc. Adv. Science.

791. PALLA.

1816. Hübn., Verz. 47: **Decius** (Decia). Sole species, and therefore type. Used by Kirby (Syn. Cat.) in same sense.

See also Phyllophasis and Philognoma.

792. PALLENE.*

1848. Doubl., Gen. Diurn. Lep., pl. 41: *Eupithes.* Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 289: the same.

The name is preoccupied in Coleoptera (Meg 1823; Lap. 1836), in Crustacea (Johnst. 1837), and in Birds (Less. 1837).

793. Pamphila.

1807. Fabr., Ill. Mag. vi. 287: comma, **Palæmon** (Paniscus), malvæ (Fritillum, lavateræ).

1828. Steph., Ill. Brit. Ent. Haust. i. 99: employs it for Palæmon (Paniscus), comma, and others, placing malvæ elsewhere.

1837. Curtis, Guide, 2d Ed. 174: makes similar use of it.

1840. Westw., Gen. Syn. 88: specifies comma as type.

1840 [ined.?] Ramb., Faune Ent. Andal. 321: malvæ, Proto, etc.

1858. Ib., Cat. Lép. Andal. 78: uses it for Proto and others.

1858. Kirb., List Brit. Rhop.: employs it for sylvanus only, a species not mentioned by Fabricius.

1869. Butl., Cat. Fabr. Lep. 276: uses it for several species, including only comma of Fabricius.

1870. Butl., Ent. Monthl. Mag. vii. 93: specifies comma as type.

1871. Kirb., Syn. Cat. 596: employs it in a very wide sense, including comma.

1872. Crotch, Cist. Ent. i. 67: says that comma is type, through Dalman's action in 1816. But Dalman did not use the name Pamphila even as a synonyme!

1872. Scudd., Syst. Rev. 56: specfies comma as type.

Comma, however, cannot be taken as the type, for in 1832 it virtually became the type of Erynnis (q. v.); malvae already belonged to Hesperia in 1798; and therefore Palaemon must be taken as the type. See Carterocephalus and Steropes.

794. Panara.

1847. Doubl., List Br. Mus. 8: Sagaris (Satnius), **Thisbe** (Iarbas).

1851. Westw., Gen. Diurn. Lep. 442: employs it for Thisbe (Iarbas), Phereclus (Barsacus), and Sagaris (Satnius), the last with a query.

Thisbe should therefore be considered the type; and in this sense it is used by Bates and Kirby.

795. Pandemos.

1816. Hübn., Verz. 25: Placidia, Liberia, **Pasiphae** (Arcassa), Lagus (Lagis).

1847. Doubl., List Br. Mus. 7: employs it for Pasiphae (Arcas) and others.

1851. Westw., Gen. Diurn. Lep. 440: does the same, and specifies Pasiphae (Arcas) as type.

1867. Bates, Journ. Linn Soc. Lond. ix. 456: uses it for Pasiphae (Arcas) only.

1871. Kirb., Syn. Cat. 332: follows Bates.

796. PANDITA.

1858. Moore, Cat. Lep. E. Ind. Co. i. 181: **Sinope.** Sole species, and therefore type.

Used in same way by Felder and Kirby.

797. PANDORA.*

1848. Boisd. in Doubl., Gen. Diurn. Lep., pl. 43: *Prola.* Sole species, and therefore type.

1850. Boisd. in Westw., Gen. Diurn. Lep. 300: the same.

The name is subsequently used by Felder; but it is preoccupied in Mollusks (Brug. 1791; Meg. 1811), in Acalephs (Eschsch. 1829), and in Diptera (Halid. 1833). See Batesia.

798. PANOPEA.*

1816. Hübn., Verz. 39: Semire, Lucretia.

1850. Westw., Gen. Diurn. Lep. 281: employs it for the same and another.

1861. Feld., Neues Lep. 27 [Panopæa]: description only.

1865. Herr.-Schaeff., Prodr. i. 65 [Panopæa]: uses it for Hübner's species and others.

1869. Butl., Cat. Fabr. Lep. 95: the same.

But the name is preoccupied through Panopæa (Mén., Moll. 1807). See Pseudacræa.

799. PANOPLUIA.*

1864. Reak., Proc. Ent. Soc. Phil. ii. 503: no species mentioned.

Indeed, it is established as an hypothetical genus, for a form of Papilionides, with an anopluriform larva, yet to be discovered!! Credat Judæus Apella!

800. PANSYDIA.

1872. Scudd., Syst. Rev. 60: **Cunaxa** (Cunaxa, Mesogramma). Type specified as Cunaxa (Mesogramma).

801. PANTHIADES.

1816. Hübn., Verz. 79: **Pelion** (Thallus, Pelion). Sole species, and therefore type.

1869. Butl., Cat. Fabr. Lep. 197: employs it for Pelion and five others.

802. Pantoporia.

1816. Hübn., Verz. 44: Phærusa, Nefte, **Hordonia**, Dorcas (Mardania).

Hordonia may be taken as the type.

803. Paphia.*

1807. Fabr., Ill. Mag. vi. 282: I. *Jason* (Jasius), Pollux; II. Varanes, Morvus (Laertes), Chorinæus; III. Medon, Astyanax (Ursula); IV. Odius (Orion), Isidora (Itys), Acontius (Antiochus).

1829. Meig., Eur. Schmett. i. 95: uses it for Jason (Jasius) only, which therefore becomes type, as stated by Crotch (Cist. Ent. i. 66).

It has subsequently been used in same sense by many naturalists, but is preoccupied in Mollusks (Lam. 1801). See Charaxes and Jasia.

804. Papilio.

[1735. Linn., Syst. Nat. ed. i. (Fee's Reprint, p. 76): no species mentioned; intended to include all Lepidoptera, divided into three groups, of which butterflies form the first.

1736. Ib., Acta Upsal. iv. 117: species mentioned (without names) are, as given by Hagen:* rhamni, brassicæ, rapæ, napi, cratægi, Apollo, Antiopa, polychloros, urticæ, c. album, Io.

1740. Ib., Syst. Nat. ed. ii. 60: no species mentioned; divided into several groups by the structure of the antennæ and mouth parts, those "pedibus 4," *i.e.* Nymphales, placed first. Essentially the same arrangement occurs in the third, fourth, and fifth editions.

1746. Ib., Faun. Suec. ed. i. 232: the butterflies are divided into two groups, according as they have four (serviceable) or six legs. Species occur again without names, but numbered from 772 to 807 inclusive; 772 was afterwards named Antiopa.

1748. Ib., Syst. Nat. ed. vi. 63: species are introduced for the first time in a general work, but still unnamed. Sixteen butterflies only are mentioned, all of them before treated of in the Fauna Suecica. Antiopa heads the list. The arrangement of the seventh and ninth edition is identical; the eighth edition contains no animals.

I have introduced the foregoing only for its historic interest. The reader will find fuller details in papers by Dr. Hagen and myself in the Canadian Entomologist, vol. vi. pp. 143–145, 163–166. In this matter I hold to the views of Agassiz, who lays down as a maxim for genera: *Cum binominalis nomenclaturæ Linnæus sit auctor, illa de prioritatu lex ad anteriorum auctorum opera non est retorquenda.*† I do not therefore deem even Linné's action (previous to 1758, when binomial nomenclature was founded) to have had any binding force; yet, in view of the opinions I expressed in my Systematic Revision (p. 16), without examination of

* Can. Ent. vi. 165. † Nomencl. Zoöl. Introd. xx.

Linné's action previous to 1758, it is interesting to discover that, in the first mention of species under Papilio, Antiopa is introduced, and Machaon (or any other swallow-tail) is not; further, that Antiopa is mentioned in every subsequent use of the generic name by Linné, and that, in every instance, excepting in 1786, when species are first referred to, the group to which Antiopa belongs, or, if species are directly mentioned, this species itself, stands first upon the list, as if that insect, at least, were always in his thought when Papilio was recorded. I repeat, however, that this consideration has no binding force whatsoever.]

1758. Ib., Syst. Nat. ed. x. i. 458: employs it for all butterflies then known, which are now described in full, and supplied with binomial nomenclature for the first time. They are divided as follows: Equites (Trojani, Achivi), Heliconii, Danai candidi, Danai festivi, Nymphales (gemmati, phalerati), Plebeii (rurales, urbicolæ), Barbari. Among the butterflies occur Antiopa, Machaon, Podalirius, and Memnon.*

1793. Fabr., Ent. Syst. iii. i. 1, 258: removes from this great group all the Rurales and Urbicolæ, under the name of Hesperia, thus confining Papilio to the Nymphales and Papilionides.

1801. Schrank, Faun. Boica, ii. i. 152, 188: restricts the name still further to the Nymphales, and divides the group, thus limited, into sections, as follows: † I. populi (Semiramis, populi), Sibylla (Sibilla), Camilla, aceris (Lucilla); II. Atalanta, cardui, Io (Jo), Antiopa, Polychloros, urticæ, c. album, Levana (Prorsa, Levana); III. Paphia, Adippe (Syrinx, Adippe), Niobe, Aglaia (Agluja), Lathonia, Dia, Selene (Thalia); IV. Athalia (Phœbe), Maturna, Cynthia (Cinthia), Hecate, Ino (Dictynna), Aurinia (Artemis), Didyma (Cinxia), Cinxia (Trivia), Lucina.

1805. Latr., Sonn. Buff. xiv. 108: first restricts the name to the "swallow-tails," but erroneously, as these had already been excluded by Schrank's limitation.

In this action he has been followed by all authors for nearly seventy years, until now it has become the all but universal custom to apply it to an immense group of over three hundred species, really composed of a vast number of genera, as any one may judge by a comparison of their earlier stages, which show greater differences than can be found in any other generally accepted genus of butterflies. Compare also Felder's study of this great group.

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* I specify these, on account of what follows.

† All the names are used by Linné.

1810. Latr., Consid. 440: specifies Machaon as the type, but, of course, erroneously.

1815. Oken, Lehrb. i. 722: makes this one of his groups of Emesis, and refers to it Melander (one of the Vestales). See also Pieris.

1816. Hübn., Verz.: makes no use of it whatever.

1832–33. Swains. Zoöl. Ill. ii. 95: considers Memnon a "pre-eminently typical" species.

1836. Curtis, Brit. Ent. pl. 578: specifies Podalirius as the type.

1840. Westw., Gen. Syn. 87: specifies Machaon as the type.

1864. Reak., Proc. Ent. Soc. Phil. ii. 60, 62: separates the swallow-tails into several genera, retaining Papilio for one of the groups, including Memnon, Machaon, Thoas, Glaucus (Turnus), etc.

1872. Crotch, Cist. Ent. i. 60: says that Cuvier, in 1799, marked Machaon as the type.

But nothing can be found in the Tableau Élémentaire to warrant such a statement. Cuvier places all the butterflies under Papilio, dividing it into sections, to which the names Nymphales, Danai, Parnassii, Heliconii, Equites, and Plebeii are given; and under Equites he gives "P. Machaon" as an example or type. Certainly, from the contents of Cuvier's work, there is no more reason for selecting this as type than "P. Antiopa," which is the first example given under the Nymphales.

1872. Scudd., Syst. Rev. 11: specifies Antiopa as the type.

See Scudderia, Amaryssus, Princeps, Iphiclides, and Iliades.

805. Paramacera.

1868 (Feb.). Butl., Ent. Monthl. Mag. iv. 194: Conhiera (a MS. species) given as type. No species whatever are described.

1868. Ib., Cat. Sat. 98: **Xicaque**. Sole species, and therefore type.

Probably Butler found his Conhiera to be synonymous with Reakirt's Xicaque, and therefore simply suppressed his own name; but it would have been well to have simply stated the fact, if it were so.

806. Paramimus.

1816. Hübn., Verz. 115: **Scurra**, Talaus, Eumelus.

1869. Herr. Schaeff., Prodr. iii. 52: without mention of species.

1870. Butl., Ent. Monthl. Mag. vii. 97: specifies Scurra as type.

807. Paraplesia.*

1862. Feld., Wien. Ent. Monatschr. vi. 26: *Adelma*. Sole species, and therefore type.

According to Felder, this name is preoccupied. See Isodema.

808. PARARGE.

1816. Hübn., Verz. 59: **Aegeria** (Egeria, Xyphia). Sole species, and therefore type, as stated by Butler, and as used by Stephens, Rambur, Heydenreich [Pararga], Staudinger [Pararga, 1861; Pararge, 1871], and Herrich-Schaeffer [Pararga].

809. PARDALEODES.

1870. Butl., Ent. Monthl. Mag. vii. 96: **Edipus**, Laronia. Edipus specified as type.

1871. Kirb., Syn. Cat. 625: uses it in the same way.

810. PAREBA.

1848. Doubl., Gen. Diurn. Lep. 142: **vesta**. Sole species, and therefore type.

811. PARIDES.

1816. Hübn., Verz. 87: **Echelus**, Æneas, Æneides (Gargasus), Anchises (Lysander), Vertumnus, Sessostris.

Echelus may be taken as the type.

812. PARNASSIUS.

1805. Latr., Sonn. Buff. xiv. 110: **Apollo**, Mnemosyne, Polyxena (Hypsipyle), Rumina.

1810. Ib., Consid. 440: Apollo specified as type.

1815. Oken, Lehrb. i. 725: uses it for Apollo and others.

1816. Hübn., Verz. 90: [Parnassis], Apollo, Phœbus (Delius), Mnemosyne.

1816. Lam., Hist. Nat. An. sans Vert. iv. 32: Apollo, Mnemosyne.

1844. Doubl., List Br. Mus. 21: Apollo and others.

1847. Ib., Gen. Diurn. Lep. 26: the same.

1864. Feld., Spec. Lep. 39: divides the species, twenty-seven in number, into two sections, placing Mnemosyne in the first and Apollo in the second.

See Doritis and Therius.

813. PARNES.*

1847. Doubl., List Br. Mus. 18: Nycteis, Philotes (both unpublished species).

1851. Westw., Gen. Diurn. Lep. 464: the same. Both are described, and Nycteis figured.

1867. Bates, Journ. Linn. Soc. Lond. ix. 436: the same.

1871. Kirb., Syn. Cat. 111: the same.

If the name could be retained, it should be with Doubleday's name, and the date 1851; and Nycteis could most appropriately be taken as type; but it is preoccupied through Parnus (Fabr., Col. 1792).

814. Paromia.*

1861. Hewits., Exot. Butt. ii.: *pulchra.* Sole species, and therefore type.

The name is preoccupied in Coleoptera (Westw. 1850).

815. Parrhasius.

1816. Hübn., Verz. 79: Timoleon, Arogenus, Hemon (Acmon, Hemon), **Polibetes** (Polybetes), Lisus.

Polibetes may be taken as the type.

816. Parthenos.

1816. Hübn., Verz. 38: **Sylvia.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 230: the same and others.

See Minetra.

817. Pathysa.

1864. Reak., Proc. Ent. Soc. Phil. iii. 503: Sarpedon, Agamemnon, Eurypylus, **Antiphates,** Ajax (Marcellus, Ajax), Podalirius? Sinon.

Antiphates may be taken as the type.

818. Pavermia.*

1864. Reak., Proc. Ent. Soc. Phil. iii. 503.

This is another of Reakirt's astonishing hypothetical genera, established upon supposititious forms of swallow-tails, with "vermiform" larvæ, yet to be discovered!

819. Pavonia.*

1823. God., Encycl. méth. Suppl. 807: Actorion, Aorsa, Automedon, Eurylochus, Ilioneus, Teucer, Idomeneus, Demosthenes (Inachis), Martia, Taramela, Batea (Saronia), Syme (Acadina), Rusina, Creusa (Anaxandra), Darius (Anaxerete), Hercyna (Anosia), Darius, Œthon, Berecynthus, Xanthus, Cassiope (Caryatis), cassiæ.

The name has since been used by several authors, but is preoccupied in Polyps (Lam. 1816), as well as in Lepidoptera (Hübn. 1816).

820. Pedaliodes.

1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 267: **Poesia,** Proerna, Pisonia (Pisonia, dejecta), Perperna, Phanias, Paneis,

Polusca, Pausia, Piletha, Prytanis, Phœnissa, Physcoa, Porina, Peucestas, Pallantis, Pylas, Plotina, Parepa Phila, Phæa, Peruda, Panyasis, Napæa. Poesia specified as type.

Subsequently used by Butler and Kirby.

821. PELEUS.*

1832–33. Swains., Zoöl. Ill. ii. 75: Dan (Eacus), Gentius, *Peleus*. Peleus specified as type.

The name is founded on that of one of the species upon which the genus is founded, and therefore falls. It is also preoccupied through Pelias (Merr., Rept. 1820). See Entheus and Phareas.

822. PELIA.*

1848. Doubl., Gen. Diurn. Lep., pl. 30: *Lamis*. Sole species, and therefore type.

1849. Ib., ib. 229: the same.

Subsequently used by Felder, but the name is preoccupied in Crustacea (Bell, 1835). See Peria.

823. PELION.*

1858. Kirb., List Brit. Rhop.: *Thaumas* (linea). Sole species, and therefore type.

The name is preoccupied; see the preceding. See also Adopæa.

824. PELLICIA.

1870. Plötz in Herr.-Schaeff., Correspondenzbl. Zoöl.-min. Ver. Regensb. xxiv. 159: Macareus, Macarius, chloracephala (chlorocephala), **dimidiatus** (dimidiata), and several MS. species.

Dimidiatus may be taken as the type.

825. PENETES.

1849. [Boisd. in] Doubl., Gen. Diurn. Lep., pl. 58: **Pamphanis**. Sole species, and therefore type.

1851. Boisd. in Westw., Gen. Diurn. Lep. 347: the same.

So used by Herrich-Schaeffer and Kirby.

826. PENTHEMA.

1848. Doubl., Gen. Diurn. Lep., pl. 39: **Lisarda**. Sole species, and therefore type.

1850. Westw., Gen. Diurn. Lep. 281: the same.

Subsequently used by Felder and Kirby. The name is unpleasantly near to Penthimia (Germ., Hemipt. 1821).

827. Pentila.

1847. [Boisd. in] Doubl., List Br. Mus. 57: **undularis**, and an unnamed species;* but undularis was undescribed until 1866, by Hewitson.

1851? Westw., Gen. Diurn. Lep., pl. 76: Zymna.

1852. Boisd. in Westw., Gen. Diurn. Lep. 503: undularis [still inedited], Abraxas, Acræa, and, with a query, Evander.

Abraxas and Acræa are figured (pl. 77), but as species of Liptena, which Westwood at the time of the publication of the plates considered synonymous with Pentila. Zymna is placed in Miletus.

1866. Hewits., Exot. Butt. iii. 119: Mr. W. F. Kirby has kindly given me the following abstract of Hewitson's remarks, to which I have no personal access: —

"Westwood in error used Liptena on pl. 77 (Gen. Diurn. Lep.), and then adopted the name Pentila, applied by Boisduval to a part only, not knowing that Tingra was synonymous. Tingra was earlier, but uncharacterized, so Pentila must stand. Westwood's first species, undularis, was Boisduval's type of Pentila; but, as Westwood's dissections were made from tropicalis,† it should stand as Westwood's type. Pentila includes tropicalis and Peucetia."

1868. Herr.-Schaeff., Prodr. iii. 13: uses it in the manner indicated by Hewitson.

1871. Kirb., Syn. Cat. 335: the same.

As will be seen from the above, the generic name, when first proposed, was founded upon undescribed species, and the characters of the genus were also withheld. It was first recognizable when Westwood figured a species, Zymna, under that name; but shortly afterward, and before any further use of the generic name, he confessed himself in error in supposing this to belong to Boisduval's genus. The latter he now characterized (probably from an examination of the first three species on his list), and placed therein the species first referred to it by Boisduval (though still unpublished), together with others, one of them doubtless the unnamed species referred to the genus by Doubleday. Still later, in 1866, Hewitson described undularis; and since, according to Kirby, it is congeneric with Acræa, it may most properly be considered the type of this genus, which should date from 1852. See Liptena and Tingra.

828. Peplia.

1816. Hübn., Verz. 20: Lamis, **caricæ**, Pelops (Pelope), Lysimon

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* Probably Abraxas or Acræa.

† This cannot be true, for Westwood remarks of tropicalis: "An insect which I have not had an opportunity of examining," l. c. 504.

(Lisimæna), Molpe, Cachnus (Damæna), Menalcus (Menalcis), Mantus (Mante), Hebrus (Pelidna), Aristus (Ariste).

The group is synonymous with Desmozona and Heliochlæna, which fall before it. Caricæ may be taken as the type. See also Nymphidium.

829. Pepliphorus.

1816. Hübn., Verz. 71: Euchylas, **Cyanea** (Cyanus).

Cyanea may be taken as the type.

830. Pereute.

1867. Herr.-Schaeff., Prodr. ii. 11: **Callinice**, Charops (marina), Autodyca (Autodyce), Telthusa, Leucodrosime (Leucodrosyne).

1870. Butl., Cist. Ent. i. 34, 40: specifies Callinice as type.

1871. Kirb., Syn. Cat. 428: follows Herrich-Schaeffer, but includes in it the genus Leodonta.

831. Peria.

1871. Kirb., Syn. Cat. 205: **Lamis**. Sole species, and therefore type.

Proposed to supplant Pelia, of which Lamis was the type.

832. Perichares.

1872. Scudd., Syst. Rev. 60: **Corydon**, Trinitad, marmorata, Sandarac. Corydon is specified as type.

833. Peridromia.*

1836. Boisd., Spec. gén., pl. 7 C.: *Arethusa*. Sole species, and therefore type.

Used similarly by Doubleday, Felder, and Herrich-Schaeffer. The name is preoccupied through Peridroma (Hübn., Lep. 1816), which has the same derivation. See Ageronia.

834. Periplacis.

1837. Gey. in Hübn., Zutr. v. 32: **Glaucoma**. Sole species, and therefore type.

835. Periplysia.

1871. Gerst., Arch. f. Nat. xxxvii. i. 358: **Leda**. Sole species, and therefore type.

1873. Ib., Faun. Sans. 370: the same.

836. PERISAMA.

1849. Doubl., Gen. Diurn. Lep. 240: **Bonplandii,** Lebasii, D'Orbignyi (D'Orbignii), Euriclea, Humboldtii, Oppelii, Philinus? and a MS. species.

1861. Feld., Neues Lep. 20: no species are cited.

1871. Kirb., Syn. Cat. 208: follows Doubleday and adds other species.

Bonplandii may be taken as the type.

837. PEROPHTHALMA.

1851. Westw., Gen. Diurn. Lep. 455: **tenera.** Sole species, and therefore type.

838. PERRHYBRIS.

1816. Hübn., Verz. 91: **Pyrrha** (Eueidias), Medusa (Epimedusa).

1867. Herr.-Schaeff., Prodr. ii. 10: employs it for a large number of species, including Pyrrha, but not Medusa. Pyrrha is therefore the type.

1871. Kirb., Syn. Cat. 478: follows Herrich-Schaeffer.

839. PETAVIA.*

1828. Horsf., Descr. Cat. Lep. E. Ind. Co. 59, expl. pl. 2: *Petavius* (Sakuni).

This name falls, because derived from the species on which the genus is grounded. Moreover, we have nothing to do with it here, as it is not a butterfly.

840. PETREUS.*

1832–33. Swains., Zoöl. Ill. ii. 110: *Peleus* (Thetys). Sole species, and therefore type.

The plate consists solely of the earlier stages of a butterfly, belonging to the Tribuni. The characters of the group are drawn up partly from the perfect insect (represented on pl. 59, and referred to Marius, while here to the subgenus Petreus, — a nymphalideous insect) and half from the caterpillar, belonging, as stated, to a totally different group! The name therefore must be dropped altogether. Moreover, Petreus is one of the synonymes of Peleus. See also Athena.

841. PHÆDRA.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 123: *Thetys* (terricola, insularis). Sole species, and therefore type.

1868. Herr.-Schaeff., Prodr. iii. 19: employs it for a large number of species, including Thetys.

The name is taken from one of the synonymes of the species upon which the genus is grounded, and therefore it must be dropped. See Curetis, Anops, and Candalides.

842. Phædyma.

1861. Feld., Neues Lep. 31: **Heliodora**, Sankara.

Heliodora may be taken as the type.

843. Phalanta.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. expl. pl. 7: *Phalanta*. Sole species, and therefore type.

As the name is founded upon that of the only species, it falls. See Atella.

844. Phanessa.*

1837. Sodoffsk., Bull. Mosc. x. 80: proposed as a more correct spelling for Vanessa.

845. Phanus.

1816. Hübn., Verz. 114: **vitreus**. Sole species, and therefore type.

Subsequently thus used by Butler and Herrich-Schaeffer.

846. Phareas.*

1852. Westw., Gen. Diurn. Lep. 515: Eumelus, Dumerilii, Talaus, Busiris, Peleus, Gentius, Procas, Pertinax, Cœleste, Loxus, Tertullianus, Julettus. Gentius and Peleus specified as typical.

1869. Butl., Cat. Fabr. Lep. 283: employs it for six species, including Gentius.

Peleus being already type of Entheus, and Gentius being strictly congeneric, this name must give place to Entheus. See also Peleus.

847. Phasis.

1816. Hübn., Verz. 73: **Thero** (Salmoneus), Thysbe (Palmus, Nais).

1869. Butl., Cat. Fabr. Lep. 176: employs it for Thero (Rumina), which thereby becomes type.

848. Pheles.

1858. Boisd. in Herr.-Schaeff., Exot. Schmett. 77: **Heliconides**. Sole species, and therefore type.

Used in same sense by Bates and Kirby.

849. Phemiades.

1816. Hübn., Verz. 112: Ephesus, Edipus (Edippus), Epictetus, **Phineus**, Augias.

Phineus may be taken as the type.

850. Philæthria.

1820. Dalm. in Billb., Enum. Ins. 77: I. Hippona; II. **Dido**, Phærusa, Julia.

Dido may be taken as the type.

851. Philocala.

1820. Billb., Enum. Ins. 79: Feronia, **Amphinome**, Orithya, Genoveva, Œnone, cardui, Huntera, Atalanta (Atalantha), Levana (Prorsa, Levana), Polynice, Ilithya.

Felder (Neues Lep. 17) divides Ageronia into four sections, the second of which, unnamed, contains only Amphinome. This may be taken as the type of Philocala.

852. Philognoma.*

1844. [Boisd. in] Doubl., List Br. Mus. 112: Decius, Varanes.

1850. Boisd. in Westw., Gen. Diurn. Lep. 310: Decius, Varanes, Laodice, Lichas. The latter is figured.

The name falls before Palla.

853. Philonoma.*

1820. Billb., Enum. Ins. 78: proposes, without reason, to employ this name for Neptis. Of course it falls.

854. Philoodus.

1840. Ramb., Faune Ent. Andal. ii. 308: **Nostrodamus** (Nostradamus, Lefebvrei). Sole species, and therefore type.

855. Phlebodes.

1816. Hübn., Verz. 107: **Pertinax**, Saturnus.

1870. Butl., Ent. Monthl. Mag. vii. 93: Pertinax is specified as the type.

856. Phlogris.*

1822–26. Hübn., Exot. Schmett. ii.: *Melpomenè*. Sole species, and therefore type.

The name falls before Sunias (q. v.).

857. Phocides.

1816. Hübn., Verz. 103: **Palemon** (cruentus), Alardus, Lisias (Lisiades).

Lisias does not belong to the family in which this was placed by Hübner, and therefore cannot be taken as the type, Alardus belongs to Telegonus, and therefore Palemon must be taken as the type. See Dyscnius.

858. PHŒBIS.

1816. Hübn., Verz. 98: Philea (Melanippe), Crocale (Jugurtha), **Argante** (Cypris), Eubule (Eubule, Drya).

1873. Butl., Lep. Exot. i. 155: designates Argante (Cypris) as the type.

859. PHOLISORA.

1872. Scudd., Syst. Rev. 51: **Catullus**, Hayhurstii, Azteca. Catullus specified as type.

860. PHORCIS.*

1816. Hübn., Verz. 62: Scæa, Stygne (Epistygne), Gorge.

The name falls before Erebia. See also Gorgo, Marica, Syngea, Epigea, and Oreina.

861. PHRISSURA.

1870. Butl., Cist. Ent. i. 37, 49: Cynis. Sole species and designated type. [See, however, additional note, p. 293.]

862. PHRYNE.*

1843. Herr.-Schaeff., Schmett. Eur. i. 90: *Phryne* (Tircis). Sole species, and therefore type.

The name is taken from one of the synonymes of the species upon which the genus was founded, and therefore falls. It may also be preoccupied in Reptiles (Fitz. 1843). See Triphysa.

863. PHULIA.

1867. Herr.-Schaeff., Prodr. ii. 17: **Nymphula**. Sole species, and therefore type, as stated by Butler.

864. PHYCANASSA.

1872. Scudd., Syst. Rev. 56: **Viator**. Sole species and designated type.

865. PHYCIODES.

1816. Hübn., Verz. 29: **Tharos** (Cocyta), Liriope.

1848. Doubl., Gen. Diurn. Lep. 181: employs it for these and many others.

1850. Steph., Cat. Brit. Lep. 259: uses it for Tharos only, which thereby becomes type.

1872. Scudd., Syst. Rev. 25: specifies Tharos (Cocyta) as type.

866. PHYLLOPHASIS.*

1841. Blanch., Hist. Ins. iii. 447: Galanthis (Galanthus), Varanes (Veranes).

This name falls before Palla and Siderone.

867. PHYSCÆNEURA.

1857. Wallengr., Rhop. Caffr. 32: **Panda.** Sole species, and therefore type.

868. PHYTALA.

1847. [Boisd. in] Doubl., List Br. Mus. 20: **Elais.** Sole species, but unpublished, and the genus uncharacterized.

1852. Boisd. in Westw., Gen. Diurn. Lep. 471: Elais. The species figured.

It is therefore type, and the genus should bear date 1852.

869. PICANOPTERYX.

1857. Wallengr., Rhop. Caffr. 7: I. Severina, Gidica (Doubledayi), Mesentina, Gidica (Westwoodi); II. **Eriphia,** Charina (Simana, alba).

1858. Ib., K. Vetensk. Acad. Förh. xv. 75: I. Severina; II. Eriphia, Ada.

The first section being synonymous with Belenois, Eriphia may be taken as the type. See Herpænia.

870. PIERELLA.

1851. Westw., Gen. Diurn. Lep. 365: **Nereis,** Rhea (Dindymene), Lena, Astyoche (Larymna), Dracontis (Lena, Dracontis).

1864. Herr.-Schaeff., Prodr. i. 55: the same and others.

1868. Butl., Ent. Monthl. Mag. iv. 195; Cat. Sat. 103: specifies Nereis as type.

871. PIERIS.

1801. Schrank, Fauna Boica, ii. i. 152, 160: I. Apollo; II. Polyxena, Machaon, Podalirius; III. cratægi, brassicæ, **rapæ,** napi, sinapis, Daplidice, cardamines; IV. rhamni, Palæno, Hyale.

1805. Latr., Sonn. Buff. xiv. 111: restricts it to the third and fourth groups, specifying, of Schrank's species, rhamni, Hyale, cratægi, brassicæ, napi, Daplidice, sinapis, cardamines.

1809. Ib., Gen. Crust. et Ins. iv. 203: restricts it still further to Schrank's third section, and divides it thus: I. *a*, cratægi, brassicæ, Daplidice, cardamines, etc.; *b*, sinapis; II. Crisia.

1810. Ib., Consid. 440: specifies brassicæ as type; but that is already type of Mancipium (q. v.).

1815. Oken, Lehrb. i. 727: employs it for the swallow-tails.

1816. Lam., Hist. Nat. An. sans Vert. iv. 30: brassicæ and others, including rapæ.

1816. Hübn., Verz. 53: employs it for species of another family.

1827. Steph., Ill. Brit. Ent. Haust. i. 25: restricts it to cratægi, but improperly. See Aporia.

1831. Curtis, Brit. Ent., pl. 360: also specifies cratægi as type.

1832–33. Swains., Zoöl. Ill. ii. 69: designates Belisama as type; but it is not even one of Schrank's species.

1836. Boisd., Spec. gén. 434: employs it for all of Schrank's third group, excepting sinapis and cardamines, and this has been its general use ever since.

Since all of the other species given by Schrank must be taken as types of other genera (see Aporia, Mancipium, Pontia, Euchloe, and Leptidia), rapæ may be taken as the type, as it is virtually included in the group by Latreille in 1809. This, too, would best accord with modern usage.

1840. Westw., Gen. Syn. 87: also specifies cratægi as type.

1870. Butl., Cist. Ent. i. 37, 49: considers Demophile (Amathonte) as type. This, he says, is the type of Boisduval's Pieris [it was simply his first species]; Apollo, that of Schrank's; Leucippe, that of Latreille and Godart; he adopts Demophile, because "we ought to have a genus Pieris in the Pierinæ." But it was not mentioned by Schrank.

1872. Scudd., Syst. Rev. 41: specifies brassicæ as type, erroneously.

See Mancipium, Ganoris, and Catophaga.

872. Pierites* (fossil).

1849. Herr, Insektenf. Oening. ii. 182: *Freyeri*. Sole species, and therefore type.

Falls before Synchloe, with which it is synonymous. In 1840 a group of butterflies was named Piérites by Blanchard and Brullé; but it would hardly affect this, for the name is not Latin, but a Gallicized form of Latin.

873. Pindis.

1869. Feld., Verhandl. Zoöl.-bot. Gesellsch. Wien. xix. 475: **squamistriga.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 108: the same.

874. Pisola.

1865. Moore, Proc. Zoöl. Soc. Lond. 785: **Zennara.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 583: the same.

875. PITHECOPS.

1828. Horsf., Descr. Cat. Lep. E. Ind. Co. 66: **Hylax.** Sole species, and therefore type.

1847. Doubl., List Br. Mus. 57: the same.

1850. Steph., Cat. Brit. Lep. 18: employs it for Argiolus.

876. PLANEMA.

1848. Doubl., Gen. Diurn. Lep. 140: I. **Lycoa,** Gea (Jodutta, Carmentis); II. Gea, Euryta (Euryta, Umbra).

Lycoa may be taken as the type.

877. PLASTINGIA.

1870. Butl., Ent. Monthl. Mag. vii. 95: **flavescens,** tessellata, Callineura, extrusa. Flavescens specified as type.

1871. Kirb., Syn. Cat. 619: the same and others.

878. PLEBEIUS.*

1871. Kirb., Syn. Cat. App. 653: proposes to use this in the place of Cupido (in which he places most of the blues), as having been founded by Linné. Three hundred and twenty-nine species are included in it.

1872. Crotch, Cist. Ent. i. 60: says, wrongly, that Linné used this name in a generic sense, and that Cuvier, in 1799, fixed its type as Argus. See Introductory Remarks.

879. PLESIONEURA.*

1862. Feld., Wien. Ent. Monatschr. vi. 29: *curvifascia.* Sole species, and therefore type, as stated by Butler.

1871. Kirb., Syn. Cat. 620: employs it for this and others.

The name is preoccupied in Diptera (Macq. 1855). See Celænorrhinus.

880. POANES.

1872. Scudd., Syst. Rev. 55: **Massasoit.** Sole species and designated type.

881. PODALIRIUS.*

1832–33. Swains., Zoöl. Ill. ii. 105: Antiphates (Pompilius), *Podalirius* (Europæus). Podalirius specified as type.

The name being founded upon that of one of its species, it falls. It is also preoccupied in Hymenoptera (Latr. 1802). See Iphiclides.

882. POLITES.

1872. Scudd., Syst. Rev. 57: **Peckius,** Sabuleti. Peckius specified as type.

883. Polychroa.

1820. Billb., Enum. Ins. 78: **Obrinus**, Ancæus.

Obrinus may be taken as the type.

884. Polycyma.*

1862. Scott in Feld., Verh. Zoöl.-bot. Gesellsch. Wien. xii. 490: Felder says that Scott [in litt.?] proposes this for the species, which Felder there places in Holochila. Felder does not adopt the name, because it is not appropriate for most of the species. See also Erina.

885. Polydorus.*

1832–33. Swains., Zoöl. Ill. ii. 101: Aristolochiæ (Thoas), Polydorus, Polytes (Polystes, Romulus). The last two specified as types.

As the name is founded upon that of one of the species included in it, it falls. Moreover, it is preoccupied through Polydora (Bosc, Worms, 1802). See Pachlioptera.

886. Polygonia.

1816. Hübn., Verz. 36: Egea (triangulum, i. album), c. aureum, Progne, **c. album**.

1858. Kirb., List Brit. Rhop.: employs it for c. album only, which therefore becomes type.

1872. Scudd., Syst. Rev. 9: specifies c. aureum as type, but incorrectly.

See Grapta and Comma.

887. Polygonus.*

1822–26. Hübn., Exot. Schmett. ii.: *Amyntas* (lividus). Sole species, and therefore type.

The name is preoccupied through Polygona (Schum., Moll. 1817), and is very close to Hübner's own Polygonia. See Acolastus.

888. Polyommatus.

1805. Latr., Sonn. Buff. xiv. 116: betulæ, quercus, pruni, **Bœticus**, rubi, Argus, Thetis (Adonis), Endymion (Meleager), Corydon, Arion, Arcas (Erebus), Cyllarus, Semiargus (Acis), Argiolus, Alsus, Dorilas (Myopa), Phlæas, virgaureæ. Corydon alone is figured.

1807. Ib., Gen. Crust. et Ins. iv. 206: divides the group into sections, specifying a few, as follows: I. *a*, betulæ, quercus, and others not in previous list; *b*, Bœticus, Endymion (Meleager), rubi, Phlæas, virgaureæ; II. Argus, Corydon, Alsus.

1810. Ib., Consid. 440: specifies betulæ, quercus, Bœticus, and Argus as types.

1817. Ib. in Cuv., Règne An. iii. 553: specifies only Alexis (not given in the original list), as a species found in the environs of Paris, but refers to previous works for the species.

1823. God., Encycl. méth. 595: employs it for all Ephori, including all the above species.

1823. Ib., Tab. Méth. 46: does the same.

1828. Horsf., Descr. Cat. Lep. E. Ind. Co. 67: restricts the name to the blues, but only uses it for new species.

1828. Steph., Ill. Brit. Ent. Haust. 83: uses it for Argiolus and many others, all blues, including Argus.

1829. Boisd., Index, 10: follows Godart.

1830. Meig., Eur. Schmett. ii. 1: employs it for the same, excluding the hair-streaks.

1832. Renn., Consp. 17: uses it for the blues only, specifying, of those given by Latreille in the first instance, Argus, Thetis (Adonis), Corydon, Arion, Semiargus (Acis), Argiolus, Alsus, and Dorylas.

1832–33. Swains., Zoöl. Ill. ii. 133: uses it for Cassius, one of the blues.

1832–33. Boisd., Icones, 43: employs it for the coppers only.

1832. Dup., Pap. France, Diurn. Suppl. 391: the same.

1833–34. Boisd.-LeC., Lép. Amer. Sept. 122: the same.

1839. Ramb., Faune Ent. Andal. 264: places the blues here again.

1840. Westw., Gen. Syn. 88: specifies Arion as type.

1847. Doubl., List Br. Mus. 53: follows Boisduval, as do most subsequent authors.

1870. Kirb., Journ. Linn. Soc. Lond. x. 500: thinks that Corydon should be taken as the type, because figured in the first instance by Latreille.

Latreille's own action necessitates its restriction to the blues; but Corydon cannot be taken as the type, since it belongs to Rusticus, established in 1810. Nor can Argus for the same reason. The only other type of blues mentioned by him in 1810 is Bœticus, for which Polyommatus must be retained. See also Lycæna.

889. Polystichtis.

1816. Hübn., Verz. 18: Fatima (Cerca), Zeanger (Zeangira), Mandana (Mandane), Lucinda.

1872. Scudd., Syst. Rev. 28: specifies Cæneus as type.

Erroneously, through Hübner's confounding of that species with the Fatima of Cramer. Hübner's first species (No. 109) must be referred primarily to Cramer's Fatima, because he appends a mark of exclamation or approval, after the reference to his figs. A. B., and of interrogation or doubt to his C. D., showing that Cramer's A. B. (Fatima) was in Hübner's mind, unquestionably, the species referred to by his No. 109.

1873. Grote, Can. Ent. v. 144: corrects the identification of Scudder, and suggests that Fatima should be taken as the type.

This, however, became in 1818 the type of Emesis; so, too, Lucinda was placed, by another name, under Aphacitis, and must be taken as the type of that genus. Mandana belongs to Emesis, and consequently Zeanger must be taken as the type, and Polystichtis may replace Lemonias auct. nec Hübn. (Tent.). See Calospila.

890. Polyura.

1820. Billb., Enum. Ins. 79: Jason (Jasius), **Pyrrhus.**

Pyrrhus may be taken as the type.

891. Pontia.

1807. Fabr., Ill. Mag. vi. 283: cratægi, rapæ, **Daplidice**, Elathea, bella.

1815. Leach, Edinb. Encycl. 716: cratægi, brassicæ, rapæ, napi, cardamines, Daplidice, sinapis.

1816. Ochs., Schmett. Eur. iv. 30: employs it for cratægi, rapæ, Daplidice, and others.

1816. Hübn., Verz. 92: uses it for Hyparete, Eucharia, and Hierte of the same family.

1824. Curtis, Brit. Ent. pl. 48: designates Daplidice as type, which must stand, although seldom used since in this manner.

1827. Steph., Ill. Brit. Ent. Haust. i. 14: uses it for rapæ and others not in Fabricius's list, placing cratægi and Daplidice elsewhere; thus indicating rapæ as the type.

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 138, 142: divides it into several named groups, and places in Pontia proper a number of species distantly allied to those of Fabricius.

1836. Boisd., Spec. gén. 430: restricts it to several species of whites not mentioned by Fabricius.

1840. Westw., Gen. Syn. 87: specifies brassicæ as the type.

1844. Doubl., List Br. Mus. 24: follows Boisduval.

1847. Ib., Gen. Diurn. Lep. 40: does the same.

1867. Herr.-Schæff., Prodr. ii. 8: the same.
1870. Butl., Cist. Ent. i. 38, 50: designates cratægi as the type.
1871. Kirb., Syn. Cat. 439: follows Boisduval.
1872. Crotch, Cist. Ent. i. 66: designates Xiphia (Nina) as type, through Boisduval in 1836.

See Ganoris, Mancipium, and Synchloe.

892. Poritia.*

1865. Moore, Proc. Zoöl. Soc. Lond. 775: *Hewitsoni.* Sole species, and therefore type.
1871. Kirb., Syn. Cat. 409: the same.

The name is, correctly speaking, preoccupied, through Porites (Lam., Pol. 1816).

893. Potamis.

1806. Hübn., Tent. 1: **Iris.** Sole species, and therefore type.

This name, never since used, must be restored. See Apatura.

894. Potanthus.

1872. Scudd., Syst. Rev. 54: **Omaha**, Californica. Omaha specified as type.

895. Precis.

1816. Hübn., Verz. 33: **Octavia**, Dryope.
1849. Doubl., Gen. Diurn. Lep. 209: employs it for Octavia and others, to the exclusion of Dryope; and the former therefore becomes the type.

It has since been used in the same sense by Felder, Butler, and Kirby.

896. Prenes.

1872. Scudd., Syst. Rev. 60: **Panoquin**, Ocola, Hecebolus, sylvicola. Panoquin specified as type.

897. Prepona.

1836. Boisd., Spec. gén., pl. 3 B.: **Laertes** (Demodice). Sole species, and therefore type.

Since used in same sense by Doubleday, Westwood, Felder, and Kirby.

898. Priamides.

1816. Hübn., Verz. 87: Torquatus (Caudius), **Pompeius** (Hipponous, Capys), Echelus (Echemon), Euristeus, Æneas (Marcius), Sesostris (Tullus), Anchises (Anchises, Brissonius, Pompejus), Hippason (Amosis, Hippason).

Pompeius may be taken as the type.

899. PRINCEPS.

1806. Hübn., Tent. 1: **Machaon.** Sole species, and therefore type.
See Amaryssus, Papilio.

900. PRIONERIS.

1867. Wall., Trans. Ent. Soc. Lond. [3] iv. 383: **Thestylis** (Thestylis, Seta), Sita, Clemanthe (Clemanthe, Berenice), Vollenhovii, Cornelia, Philonome, Autothisbe.
1870. Butl., Cist. Ent. i. 33: specifies Thestylis as the type.
1871. Kirb., Syn. Cat. 477: employs it for all of Wallace's species and others.

901. PROCRIS.

1864. Herr.-Schaeff., Prodr. i. 23: no species mentioned.

In his list, p. 66, this name is supplanted by Acca Hübn. and Procris and Urdaneta referred to it. These cannot be placed in Acca (q.v.); but the name of the genus, being the same as that of one of the species upon which it is founded, falls. It is also preoccupied in Lepidoptera (Fabr, 1807).

902. PROMETHEUS.*

1822–26. Hübn., Exot. Schmett. ii.: *Casmilus.* Sole species, and therefore type.
It is not a butterfly.

903. PRONOPHILA.

1849. Doubl., Gen. Diurn. Lep., pl. 60: **Thelebe,** Irmina, Phoronea.
1850. Doubl., Gen. Diurn. Lep., pl. 66: Tauropolis.
1851. Westw., Gen. Diurn. Lep. 357: the same with others.
1867. Butl., Ann. Mag. Nat. Hist. [3] xx. 266; Cat. Sat. 184: specifies Thelebe as the type.
1871. Kirb., Syn. Cat. 108: uses it in Butler's sense.

904. PROTEIDES.

1816. Hübn., Verz. 105: **Idas** (Mercurius), Zestos, Exadeus, Lycidas (Lyciades), Clonius, Renaldus, Assaricus, Amphion.
1869. Butl., Cat. Fabr. Lep. 264: employs it for seven species, including Idas and Clonius (Clonias).
1870. Ib., Ent. Monthl. Mag. vii. 93: specifies Idas (Mercurius) as type.

905. PROTESILAUS.*

1832–33. Swains., Zoöl. Ill. ii. 93, 104: *Protesilaus* (Leilus), Bellerophon (Swainsonii). Protesilaus specified as type.

The name, of course, falls, from being founded upon one of the species on which the genus is established.

906. PROTHOE.

1822–26. Hübn., Exot. Schmett. ii.: **Franckii.** Sole species, and therefore type. See Œnomaus.

Used in same sense by Doubleday, Felder, and Kirby.

1850. Westw., Gen. Diurn. Lep. 266: employs it for this species only, and gives Autonema as a MS. generic synonyme of Boisduval.

907. PROTOGONIOMORPHA.

1857. Wallengr., Rhop. Caffr. 23: **Anacardii.** Sole species, and therefore type.

1861. Feld., Neues Lep. 14: Sabina, Anacardii.

Should Anacardii prove congeneric with Augustina (as given by Kirby), this name will fall before Salamis.

908. PROTOGONIUS.*

1816. Hübn., Verz. 100: *Hippona* (Fabius). Sole species, and therefore type.

Used for this species only, by Westwood, Felder, Butler, and Kirby; but the name falls before Consul. See also Fabius and Helicodes.

909. PSALIDOPTERIS.

1822. Hübn., Zutr. ii. 17: **Thucydides** (Nycha). Sole species, and therefore type.

1837. Gey. in Ib., v. 26: Terambus (Lytæa). A very different insect. See Theope.

910. PSELNA.*

1820. Billb., Enum. Ins. 77: proposes, without reason, to use this name for Hætera (q. v.).

911. PSEUDACRÆA.

1850. Westw., Gen. Diurn. Lep. 281: **Hirce**, Euryta, Boisduvalii.

1871. Kirb., Syn. Cat. 229: employs it for Hirce, Boisduvalii, and others.

Hirce may be taken as the type. See Panopea.

912. PSEUDERGOLIS.

1867. Feld., Reise Novara, 404: **Avesta.** Sole species, and therefore type.

913. PSEUDODIPSAS.

1860. Feld., Wien. Ent. Monatschr. iv. 243: **Eone.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 408: the same and others.

914. Pseudolycæna.

1858. Wallengr., K. Vet. Akad. Förh. xv. 80: **Marsyas.** Sole species, and therefore type. See Œnomaus.

915. Pseudonympha.*

1857. Wallengr., Rhop. Caffr. 31: *Hippia*, Cassius (hyperbioides), Hyperbius, Narycia.

1858. Ib., K. Vet. Akad. Förh. xv. 79: Hippia only, which therefore becomes type.

1868. Butl., Ent. Monthl. Mag. iv. 194; Cat. Sat. 93: specifies Hippia as the type.

This name must fall before Melampias.

916. Pseudopheles.*

1867. Bates, Trans. Ent. Soc. Lond. [3] v. 544: *Sericina.* Sole species, and therefore type.

The name falls before Esthemopsis, as pointed out by Bates himself.

917. Pseudopontia.*

1870 (Sept.). Plötz, Stett. Ent. Zeit. xxxi. 348: *paradoxa* (calabarica). Sole species, and therefore type.

1870. Butl., Cist. Ent. i. 57: expresses the opinion that it is not a butterfly, but a moth.

1871. Kirb., Syn. Cat. 438: employs it for the same.

The name falls before Gonophlebia. See also Globiceps.

918. Pteronymia.

1872. Butl.-Druce, Cist. Ent. i. 96: **Aletta,** Olyrilla, Notilla, fulvimargo. Aetta specified as type.

919. Pterourus.*

1777. Scop., Introd. 433: Paris and a great number of others destitute of the slightest distinguishing bond of union of any value.

They are mostly butterflies whose hind wings are prolonged into a tail. They are divided into two sections, but it would be difficult to say on what ground. The second section contains the following, among others: Hector [Papilionides], Leilus [Urania], pruni [Ephori], Proteus [Urbicolæ], Butes [Vestales].

1872. Scudd., Syst. Rev. 43: specifies Troilus (one of the Scopolian species) as type. See Euphœades.

But unreasonably and indefensibly, as the name must fall from the incongruity of the materials of which the genus is composed.

920. PTERYGOSPIDEA.

1857. Wallengr., Rhop. Caffr. 53: **Flesus** (Ophion), Motozi, Mokeesi, Sabadius (Nottoana).

1858. Ib., K. Vet. Akad. Förh. xv. 83: Flesus (Ophion) and a new species. Flesus therefore becomes type.

921. PTYCHANDRA.

1861. Feld., Wien. Ent. Monatschr. v. 304: **Lorquinii.** Sole species, and therefore type, as stated by Butler and used by different authors.

922. PTYCHOPTERYX.*

1857. Wallengr., Rhop. Caffr. 17: *subfasciatus* (Bohemanni). Sole species, and therefore type, as stated by Butler.

The name, however, is preoccupied in Diptera (Leach, 1818), and it was probably on this account that Wallengren subsequently proposed Thespia (q. v.) in its stead. The name falls before Teracolus.

923. PYCINA.

1849. Boisd. in Doubl., Gen. Diurn. Lep., pl. 48: **Zamba.** Sole species, and therefore type.

1850. Boisd. in Westw., ib. 305: the same.

Subsequently used by Felder and Kirby.

924. PYRAMEIS.*

1816. Hübn., Verz. 33: Indica (Calliroe), *Atalanta.*

1849. Doubl., Gen. Diurn. Lep. 202: employs the name for these and others, placing them in two sections, both of Hübner's in the first.

1850. Steph., Cat. Brit. Lep. 11: uses it for Atalanta only, which therefore becomes the type.

But Atalanta is already the type of Vanessa, and both species are strictly congeneric; consequently this name falls. See also Ammiralis and Bassaris.

925. PYRGUS.*

1816. Hübn., Verz. 109: *Syrichtus* (Syrichtus, Oilus, Orcus), sidæ, Tessellum, Alveus (carthami), Fritillum, malvæ (Alveolus), Sao (Sertorius), Vindex.

1850. Steph., Cat. Brit. Lep. 21, 262: employs it for malvæ (Alveolus), Syrichtus (Oileus), and alceæ (malvarum).

1852. Westw., Gen. Diurn. Lep. 516: uses it for all of Hübner's species and for others.

1858. Kirb., List Brit. Rhop.: follows Stephens.
1869. Butl., Cat. Fabr. Lep. 280: employs it for Syrichtus, sidæ, malvæ, and others.
1870. Ib., Ent. Monthl. Mag. vii. 94: specifies Syrichtus as type.

The name falls before Hesperia, all the species being strictly congeneric with malvæ, the type of that genus. See also Scelothrix and Syrichtus.

926. Pyristia.

1870. Butl., Cist. Ent. i. 35, 44: **Proterpia.** Sole species and designated type.

927. Pyronia.

1816. Hübn., Verz. 59: **Tithonus** (Tithone), Ida, Narica.
1850. Steph., Cat. Brit. Lep. 7: employs it for Tithonus only.

In this he is followed by Kirby (List, 1858), and this may be considered the type.

928. Pyrrhogyra.

1816. Hübn., Verz. 43: **Tipha,** Neærea.
1844. Doubl., List Br. Mus. 88 [Pyrrhagyra]: employs it for Tipha only, which thereby becomes type.
1850. Westw., Gen. Diurn. Lep. 252: employs it for both of Hübner's species and others. See also Corybas.

Subsequently employed similarly by Felder and Kirby.

929. Pyrrhopyge.

1816. Hübn., Verz. 103: Phidias (Bixæ), **hyperici,** Acastus (Phidias), Amyclas, Arinas.
1852. Westw., Gen. Diurn. Lep. 508 [Pyrrhopyga]: employs it for fourteen species, including all but the last of Hübner's, and adding others.
1869. Herr.-Schaeff., Prodr. iii. 56 [Pyrrhopyga]: uses it for a still greater number of species, including all of Hübner's.
1869. Butl., Cat. Fabr. Lep. 267 [Pyrrhopyga]: refers to it all of Hübner's species excepting hyperici, and adds others.
1870. Ib., Ent. Monthl. Mag. vii. 58 [Pyrrhopyga]: places here all of Hübner's species excepting Arinas, and adds several others.
1871. Kirb., Syn. Cat. 584: employs it for all of Hübner's species and others.

1872. Scudd., Syst. Rev. 46 [Pyrrhopyga]: specifies Phidias (Bixæ) as type.

Phidias, however, was taken in 1852 as type of Pachyrhopala. Hyperici may be selected as the typo of this genus.

930. Pyrrhosticta.

1872. Butl., Cist. Ent. i. 86: Lætitia "and allies." Lætitia is then the type.

931. Pythonides.

1816. Hübn., Verz. 111; Jovianus, **Cerialis** (Cerberus), **Lagia** (Herennius).

1827–37. Gey. in Hübn., Exot. Schmett. iii. [Pithonides]: employs it for Cerialis (Orcus) and Lagia (Herennius).

1869. Butl., Cat. Fabr. Lep. 285: uses it for Jovianus, Cerialis (Cerealis), and another.

1870. Ib., Ent. Monthl. Mag. vii. 97: specifies Jovianus as type.

1871. Kirb., Syn. Cat. 626: uses it for all these species and others.

Jovianus, which is generically distinct from Cerialis, cannot be taken as the type, because left out of the group by Geyer. Cerealis may be taken as the only one used by all authors.

932. Ragadia.

1851. Westw., Gen. Diurn. Lep. 376: **Crisia.** Sole species, and therefore type, as stated and employed by Butler.

1871. Kirb., Syn. Cat. 56: Crisia, Crisilda.

933. Rhaphicera.

1867. Butl., Ann. Mag. Nat. Hist. [3] xix. 164: **Satricus**, Moorei.

1868. Ib., Ent. Monthl. Mag. iv. 196; Cat. Sat. 158: specifies Satricus as type.

934. Rhetus.*

1832–33. Swains., Zoöl. Ill. ii. 33: Butes (Crameri), Rhetus, Periander. The last two are specified as types.

Afterward employed by Westwood (Gen. Diurn. Lep.), but the name must fall because based on that of one of the species upon which it was established. It is also preoccupied through Rhetia (Leach, Crust. 1818). See Diorina.

935. Rhinopalpa.*

1860. Feld., Wien. Ent. Monatschr. iv. 399: *fulva.* Sole species, and therefore type.

1861. Ib., Neues Lep. 49: Polynice, fulva.

1871. Kirb., Syn. Cat. 191: the same and others.

Mr. Kirby suggests to me that this name is probably hybrid (ῥίς, palpus), and on that account changed by Felder himself to Eurhinia (q.v.), just as he changed Teinopalpus to Teinoprosopus.

936. Rhodocera.

1829. Boisd.-LeC., 70: Mærula, rhamni, Clorinde, **Menippe** (Leachiana).

1832. Dup., Pap. France, Diurn. Suppl. 386: uses it for rhamni and Cleopatra.

1836. Boisd., Spec. gén. 597: employs it for the same species as Boisduval and LeConte, and for others.

1840. Ramb., Faune Ent. Andal. ii. 256: employs it for Cleopatra only.

1844. Doubl., List Br. Mus. 37: follows Boisduval's practice in 1836.

1847. Ib., Gen. Diurn. Lep. 70: suggests that it be used for the American species placed in that work under Gonepteryx, namely, Menippe (Leachiana), Clorinde, and Mærula of Boisduval and LeConte's list, and a few others. See also Amynthia.

1870. Butl., Cist. Ent. i. 35: specifies Menippe (Leachiana) as type.

It cannot be taken for rhamni and allies, as Duponchel's action would require, because they were reserved for Colias as early as 1810. We may therefore follow Doubleday (1847), through Butler, in considering Menippe as the type.

937. Rhopalocampta.

1857. Wallengr., Rhop. Caffr. 47: **Forestan** (Florestan), Valmaran, Keithloa.

1858. Ib., K. Vet. Akad. Förh. xv. 81: employs it for Forestan (Florestan) only, which thereby becomes the type.

938. Riodina.

1851. Westw., Gen. Diurn. Lep. 430: **Lysippus.** Sole species, and therefore type.

Thus used, for this species only, by Bates and Kirby. See Erycina.

939. Ripheus.*

1832–33. Swains., Zoöl. Ill. ii. 131: *Dasycephalus.* Sole species, and therefore type.

The name will fall because derived from a species of Drury's (Ripheus), with which this is directly compared. Moreover, it is probably a fictitious insect, having the appearance of a Uranian to which clubbed antennæ have been artificially attached.

940. RODINIA.*

1851. Westw., Gen. Diurn. Lep. 430: Jurgensenii (Jurgensenii, Montezuma), Calphurnia (Calpharnia), Periander, Aulestes (Aulestes, Glaphyra), Pandama, Tedea, Melibœus, (Melibœus, Julia), Inca.

The name must fall, because the species mentioned belong to the earlier genera Ancyluris, Diorina, Zeonia, and Euerycina.

941. ROMALEOSOMA.

1840. Blanch., Hist. Ins. iii. 448: **Eleus.** Sole species, and therefore type.

1841. Doubl., List Br. Mus. 99: Eleus and others.

1850. Westw., Gen. Diurn. Lep. 283 [Romalæosoma]: the same in three sections.

942. RUSALKIA.

1871. Kirb., Syn. Cat. 306: **Marathon,** Ctesiphon.

1873. Ib., Zoöl. Rec. for 1871, 364: Marathon given as type. See Oreas.

943. RUSTICUS.

1806. Hübn., Tent. 1: **Argyrognomon** (Argus). Sole species, and therefore type.

See Lycæides, Scolitantides, and Polyommatus.

944. SAGARITIS.

1822–26. Hübn., Exot. Schmett. ii: **Orsis** (Orseis). Sole species, and therefore type. See Myscelia.

945. SAIS.

1816. Hübn., Verz. 10: **Rosalia,** Pyrrha (Pamela).

1844. Doubl., List Br. Mus. 57: employs it for Rosalia and some unnamed species.

1848. Ib., Gen. Diurn. Lep. 131: uses it for Rosalia and Cyrianassa.

1862. Bates, Linn. Trans. xxiii. 527: specifies Rosalia as the type.

946. SALACIA.*

1823. Hübn., Zutr. ii. 25: *Phyllodoce.* Sole species, and therefore type.

The name, however, is preoccupied in Polyps (Lamx. 1816). See Scada.

947. SALAMIS.

1833. Boisd., Ann. Mus. Hist. Nat. 194: **Augustina.** Sole species, and therefore type.

1844. Doubl., List Br. Mus. 84: employs it for a large number of species, not including Augustina.

1849. Ib., Gen. Diurn. Lep. 211: restricts it to half a dozen species, including Augustina.

1861. Feld., Fam. Nymph. 13: divides it into two sections, but does not specify Augustina in either.

1871. Kirb., Syn. Cat. 192: follows Doubleday (1849).

See Protogoniomorpha.

948. SALPINX.

1816. Hübn., Verz. 17: **leucostictos** (Nemertes). Sole species, and therefore type.

949. SAROTA.

1851. Westw., Gen. Diurn. Lep. 424: Dematria, **Chrysus**.

Chrysus may be taken as the type.

950. SARROMIA.*

1851. Westw., Gen. Diurn. Lep., pl. 67: *obsoleta*. Sole species, and therefore type.

This name falls before Lymanopoda, proposed at the same time, but subsequently united by their author under the latter name (q. v.).

951. SATARUPA.

1865. Moore, Proc. Zoöl. Soc. Lond. 780: **Gopala**, Sambara, Bhagava.

Gopala may be taken as the type.

952. SATYRITES* (fossil).

1872. Scudd., Rev. Mag. Zoöl. 66: *Reynesii*. Sole species, and therefore type.

There is a name Satyrites, used for a subfamily group of butterflies by Blanchard and Brullé, in 1840; and therefore, in a memoir on fossil butterflies now in press, I have changed this name to Lethites.

953. SATYRUS.*

1810. Latr., Consid. 440: Teucer, Phidippus, Sophoræ, Piera, *Galathea*, Mæra.

These are all given as types only by Latreille; and it will be seen by comparison of the context that he intended to embrace within it all the Oreades. In a previous work (Sonnini's Buffon), he has placed all of these under his division Satyri of Nymphalis (q. v.); and in the list of names occurs Mæra (given here as one of the types of Satyrus), but it bears there the name of Satyrus (le Satyre of old authors). The name, then, is based upon a synonyme of one of the species included in the group (one of the specified types, indeed), and must therefore be dropped. Moreover, the name is preoccupied in Mammals (Tulp. 1692), and, through Satyra, in Diptera (Meig. 1803).

The subsequent history of the name is as follows: —

1819. God., Encycl. méth. 460: uses it for all the Satyrids.

1822–23. Swains., Zoöl. Ill. i. iii. pl. 159: specifies "Hyperanthus, Galathea, Semele, etc.," as types. If the name could stand, Galathea would then be type. See Agapetes.

1832. Boisduval (loc. var.): most of the European Satyrids.

1851. Westw., Gen. Diurn. Lep. 388: specifies Semele and Fidia as representative.

1858. Ramb.. Cat. Lep. Andal. 25: employs it for Arethusa and other species not given by Latreille.

1867. Butl., Entom. iii. 279: says that the "Satyrus of Godart cannot be used, as the type of that genus was Constantia of Cramer, — a species previously used by Hübner as the type of his genus Hipio."

Here are three errors, two of them based on the untenable theory that an author's first species must be taken as his type, which would be an *ex post facto* rule of great undesirability, and having no proper authority.

1868. Ib., Ent. Monthl. Mag. iv. 194; Cat. Sat. 59: specifies Actæa as type.

1872. Crotch, Cist. Ent. i. 91: erroneously refers the name back to Fabricius [Satyri], and says that Latreille (1805) fixed Megæra as the type.

954. Scada.

1871. Kirb., Syn. Cat. 23: **Phyllodoce**, Leptalina, Reckia, Philemon, Ethica, Theaphia, Xanthina, Zibia.

As this name is proposed to supplant Salacia (q. v.), Phyllodoce must be taken as the type. See Oleria.

955. Scalidoneura.

1871. Butl., Proc. Zoöl. Soc. Lond. 250: **Hermina.** Sole species and designated type.

956. Scelothrix.*

1858. Ramb., Cat. Lép. Andal. i. 63: carthami, Alveus, serratulæ, onopordi, Fritillum, malvæ (Alveolus, melotis), Galactites, cynaræ, carlinæ, cirsii, cacaliæ, centaureæ.

The name falls before Hesperia. See also Pyrgus and Syrichtus.

957. Schœnis.

1816. Hübn., Verz. 28: **Cinxia** (Delia, Cinxia). Sole species, and therefore type.

Used in same manner by Stephens (1850) and Kirby (1858). See also Mellicta.

958. SCOLITANTIDES.*

1816. Hübn., Verz. 68: Battus, Hylas.

1869. Butl., Cat. Fabr. Lep. 167: the same.

The name falls before Rusticus. See also Lycæides.

959. SCOPTES.*

1816. Hübn., Verz. 111: Alphæus (Alpheus), Protumnus [also given in same work under Thestor!), Crotopus [also given in same work under Eusalasia!].

1866. Butl., Cat. Fabr. Lep. 176: employs it for Alphæus (Alpheus) only.

This, however, cannot be taken as type, as it had been previously selected as the type of Capys. Protumnus has been chosen as the type of Thestor, and Crotopus belongs to a distinct subfamily. Owing to the somewhat heterogeneous nature of the group, and the fact that two out of the three species were also placed elsewhere by Hübner, the name may as well be dropped. See Capys.

960. SCUDDERIA.*

1873 (Aug.). Grote, Can. Ent. v. 144: *Antiopa*. Sole species and designated type.

The name falls before Papilio, previously restricted to this species, and is preoccupied in Orthoptera (Stål, April, 1873).

961. SEMELIA.

1844. [Boisd. in] Doubl., List Br. Mus. 64: **Vibilia**, Aliphera.

1870. Boisd., Lép. Guat. 35: claims the name, mentioning only Vibilia, which therefore becomes the type.

The name is very close to Semele (Schum., Moll. 1817).

962. SEMICAUDATI.*

1860. Koch, Stett. Ent. Zeit. xxi. 231: Nireus, and a number of other swallow-tails, having no sort of distinctive character but the comparative length of their tails.

The formation of the name is itself objectionable, and the appearance of such divisions as the semicaudati, caudati, and ecaudati of this author, less than half a generation ago, is an extraordinary case of the "survival" of the spirit of mediæval science. The group is mentioned here only to make this historical sketch complete.

963. SEMOMESIA.

1851. Westw., Gen. Diurn. Lep. 455: **Crœsus**, geminus.

Crœsus may be taken as the type.

964. SERICINUS.

1851. Westw., Trans. Ent. Soc. Lond. [N. S.] i. 173: **Telamon.** Sole species and designated type.

1852. Ib., Gen. Diurn. Lep. 530: the same.

1856. Gray, Pap. Brit. Mus. 78; Cat. Pap. 93: Telamon and others.

965. SETABIS.

1847. Doubl., List Br. Mus. 19: **Myrtis,** Mæonis [both species inedited].

1851. Westw., Gen. Diurn. Lep. 450: Myrtis, Serica.

Both are described, and the latter figured. It would be better, however, to designate Myrtis as the type, as one of those specified by Doubleday. Mæonis, however, may be the same as Serica, as it appears to be hitherto only a MS. name.

966. SETODOCIS.

1820. Billb., Enum. Ins. 78: Philomela (Lisandra), Dejanira, Mineus, **Peribæa** (Peribœa), Phedra, Hesione (Ocirrhoe).

Peribæa may be taken as the type.

967. SICYONIA.

1816. Hübn., Verz. 13: **Rhea** (Sara, Thamar), Apseudes, Erato (Doris).

Rhea may be taken as the type. See Laparus.

968. SIDERONE.

1822–26. Hübn., Exot. Schmett. ii.: **Ide.** Sole species, and therefore type.

1836. Boisd., Spec. gén., pl. 4 B.: the same.

Subsequently used in the same sense by Doubleday, Westwood, Felder, Kirby, etc. See also Phyllophasis.

1870. Boisd., Lép. Guat. 51: employs it for Mars and Isidora, previously placed in the same group by other authors, and quotes the genus as his own! yet, in 1836, he uses it for the sole species placed in it by Hübner!

969. SIPROETA.

1822–26. Hübn., Exot. Schmett. ii.: **Trayja.** Sole species, and therefore type. See Amphirene.

970. SIRONIA.

1823. Hübn., Zutr. ii. 31: **Tithia.** Sole species, and therefore type.

971. Siseme.

1851. Westw., Gen. Diurn. Lep. 462: Aristoteles, **Electryo.**
1867. Bates, Journ. Linn. Soc. Lond. ix. 433: the same and others.
1871. Kirb., Syn. Cat. 309: the same.

Electryo, having been figured by Westwood, may be taken as the type.

972. Sithon.

1816. Hübn., Verz. 77: **Nedymond,** Melampus.
1866. Trim., Rhop. Afr. Austr. 232: employs it for Anta (Batikeli), allied to Melampus.
1871. Kirb., Syn. Cat. 411: employs it for Nedymond and its allies, excluding Melampus.

Melampus was taken in 1863 by Hewitson to form his Deudorix, and therefore we may follow Kirby in considering Nedymond as the type.

973. Smyrna.

1822–26. Hübn., Exot. Schmett. ii.: **Blomfildia** (Blomfildii). Sole species, and therefore type.
1827–37. Gey. in Hübn., Exot. Schmett. iii.: uses it for Karwinskii.

Westwood, Felder, and Kirby use it for both these species.

974. Sospita.

1861. Hewits., Exot. Butt. ii. 91: Tantalus, Savitri (Susa), Neophron, Segecia, **Fylla,** Echerius, Tepahi.
1861. Herr.-Schaeff., Exot. Schmett. pt. 37: employs it for the first four of the above.

Fylla, being generically distinct from Echerius the type of Abisara, may be selected to represent this genus.

975. Spathilepia.

1870. Butl., Ent. Monthl. Mag. vii. 57: Tamyroides, **Clonius,** Cellus. Clonius specified as type.

Used by Kirby in the same sense.

976. Speyeria.

1872. Scudd., Syst. Rev. 23: **Idalia.** Sole species and designated type.

977. Sphænogona.

1870. Butl., Cist. Ent. ii. 35, 44: **Ectriva,** bogotana. Ectriva is specified as type; it was undescribed until later, but before further use of the generic name.

978. SPILOTHYRUS.*

1832. Dup., Pap. France, Diurn. Suppl. 415: alceæ (malvæ), **altheæ** (althea), lavateræ.

1858. Ramb., Cat. Lép. Andal. 79: employs it for the same.

1861. Staud., Cat. 14: the same.

The name falls before Urbanus. See also Carcharodus.

979. SPINDASIS.

1857. Wallengr., Rhop. Caffr. 45: **natalensis** (Masilikazi). Sole species, and therefore type.

980. SPIONIADES.

1816. Hübn., Verz. 114: **Artemides**, Alcmon (Almon), Psecas.

Artemides may be taken as the type.

981. STALACHTIS.

1816. Hübn., Verz. 27: **Phlegia**, Euterpe, Phædusa, Calliope.

1847. Doubl., List Br. Mus. 19: the same and others.

1848. Ib., Gen. Diurn. Lep. 133: uses it for Calliope, Euterpe, Susanna, and Phlegia.

1851. Westw., Gen. Diurn. Lep. 466: employs it for eight species, including all of Hübner's.

1867. Bates, Journ. Linn. Soc. Lond. ix. 457: extends it still further, employing also the Hübnerian species.

1871. Kirb., Syn. Cat. 333: uses it in the same sense.

Phlegia may be selected as the type of this genus, which is distinct from Nerias.

982. STEROMA.

1851. Westw., Gen. Diurn. Lep. 400: **Bega.** Sole species, and therefore type, as stated by Butler.

983. STEROPES.*

1832. Boisd., Voy. Astrol. 167: picta, ornata, Iacchus (Jacchus).

1836. Ib., Spec. gén., pl. 9 B.: uses it for Palæmon (Paniscus) only.

As the name is derived from that of one of the species intended, and afterwards employed, by Boisduval as one of this group, it must fall. It is also preoccupied in Coleoptera (Stev. 1806). See Carterocephalus and Pamphila.

984. STEROSIS.*

1865. Boisd. in Feld., Reise Novara, 219: *Brassolis* (robusta). Sole species, and therefore type.

The name falls before Liphyra (q. v.).

985. Stibochiona.

1868. Butl., Proc. Zoöl. Soc. Lond. 614: Nicea, **Coresia.** Coresia specified as type.

986. Stichophthalma.

1862. Feld., Wien. Ent. Monatschr. vi. 27: **Howqua.** Sole species, and therefore type.

987. Stomyles.

1872. Scudd., Syst. Rev. 55: **textor.** Sole species and designated type.

988. Strymon.

1816. Hübn., Verz. 74: **Titus** (Mopsus), pruni, betulæ, w. album, ilicis (esculi, ilicis), acaciæ, Melinus, spini (Lynceus, spini), Beon, Pan, Acis (Mars).

1850. Steph., Cat. Brit. Lep. 16, 260: places here betulæ, pruni, w. album, Titus, spini, and ilicis.

1858. Kirb., List Brit. Rhop.: uses it for only pruni, w. album, spini, and ilicis; but Thecla was restricted much earlier.

1869. Butl., Cat. Fabr. Lep. 190: employs it (sensu stricto) for eight species, including, of Hübner's, Titus, pruni, w. album, ilicis, and spini.

1872. Scudd., Syst. Rev. 32: specifies Titus as type, which follows from the action of Stephens and Butler.

989. Stygnus.*

1867. Feld., Reise Novara, 489: ***humilis.*** Sole species, and therefore type, as specified by Butler.

But the name is preoccupied in Arachnids (Perty, 1830).

990. Sunias.

1816. Hübn., Verz. 12: Phyllis, **Melpomene** (Lucia, Melpomene, Callicopis).

Melpomene may be taken as the type. See also Phlogris and Laparus.

991. Symbrenthia.

1816. Hübn., Verz. 43: **Hyppoclus** (Hippocle). Sole species, and therefore type.

1871. Kirb., Syn. Cat. 180: the same and others.

See Laogona.

992. Symetha.*

1828. Horsf., Descr. Cat. Lep. E. Ind. Co. 59, expl. pl. 2: *Symethus* (Pandu). Sole species, and therefore type.

1832. Boisd., Voy. Astrol. 72 [Simœthus]: Rex, Pandu.

The name, being derived from that of the species upon which it is grounded, falls. It is also preoccupied in Crustacea (Rafin. 1814). See Gerydus and Miletus.

993. Symmachia.

1816. Hübn., Verz. 26: Helius (Ochima), **Probetor** (Probetrix).

1837. Sodoffsk., Bull. Mosc. x. 82: not knowing that this name was already in use, proposes to employ it in place of Hesperia.

1847. Doubl., List Br. Mus. 8: employs it for Probetor and others.

1851. Westw., Gen. Diurn. Lep. 444: makes a similar but more extended use of it.

1867. Bates, Journ. Linn. Soc. Lond. ix. 437: extends it still further in the same sense.

1871. Kirb., Syn. Cat. 313: the same.

Probetor is therefore the type.

994. Symmachlas.

1820–21. Hübn., Exot. Schmett. ii.: **nigrina**. Sole species, and therefore type.

1821. Ib., Index, 5: nigrina.

995. Symphædra.

1816. Hübn., Verz. 40: Æropus (Ærope), **Thyelia** (Alcandra), Evelina, Lysandra.

1844. Doubl., List Br. Mus. 105: [Symphedra]. Employs it for Thyelia and unnamed species only.

1850. Westw., Gen. Diurn. Lep. 294: Thyelia, Æropus.

Used in same sense by subsequent authors. Thyelia becomes the type, through Doubleday's action.

996. Synalpe.*

1870. Boisd., Lép. Guat. 36: *Thirza* (Euryale). Sole species, and therefore type.

Falls before Anelia. See also Clothilda.

997. Synapta.*

1865. Feld., Reise Novara, 294: *Arion*. Sole species, and therefore type.

The name is preoccupied in Echinoderms (Eschsch. 1829).

998. SYNARGIS.

1816. Hübn., Verz. 18: Phyleus (Phyllea), Orestes (Orestessa), Soranus (Sorane), **Tytia**, Odites (Oditis).

Tytia may be taken as the type.

999. SYNCHLOE.

1816. Hübn., Verz. 94: Callidice, Autodice, Hellica, Chloridice, Daplidice, **Belemia** (Belemia, Glauce).

1844. [Boisd. in] Doubl., List Br. Mus. 76: employs this name for Erodyle, Janais, Narva (Bonplandi), and some MS. species, all of which have nothing whatever to do with Hübner's group. See Chlosyne.

1848. Boisd. in ib., Gen. Diurn. Lep. 185: follows the same course.

1858. Kirb., List Brit. Rhop.: first restores the Hübnerian sense by employing it for Daplidice, which would therefore become the type, but that it had already been taken as the type of Pontia.

1861. Feld., Neues Lep. 10: follows Doubleday.

1870. Butl., Cist. Ent. i. 38, 51: specifies Callidice as type, but wrongly.

1872. Scudd., Syst. Rev. 42: does the same, with equal error.

All the species but Belemia having been taken either for Pontia or Tatocheila (q. v.), this becomes the type.

1000. SYNGEA.*

1816. Hübn., Verz. 62: Arachne (Pronoe, Pitho), Alecto.

The name falls before Erebia. See also Gorgo, Marica, Phorcis, Epigea, and Oreina.

1001. SYNPALAMIDES.*

1822–26. Hübn., Exot. Schmett. ii.: *Mimon*. Sole species, and therefore type.

It is not a butterfly.

1002. SYRICHTUS.*

1832–33. Boisd., Icones, 230: Proto, Sao (Therapne), Orbifera (Orbifer), cacaliæ (alveus), Fritillum, Tessellum, malvæ (malvæ, Alveolus), alceæ (alceæ, malvarum), lavateræ, sidæ, carthami, altheæ.

The name of the group is derived from that of one of the species which Boisduval must have intended to include in it, and therefore falls. The first four only are described in the Icones: the others are only alluded to in his remarks on the genus. See Hesperia, Pyrgus, and Scelothrix.

1003. Syrmatia.

1816. Hübn., Verz. 23: **Dorilas** (Nyx), Rhetus (Rhete), Aulestes (Aulestis), Chorineus (Chorinea).

1847. Doubl., List Br. Mus. 4: employs the name for Dorilas only, which therefore becomes the type.

1851. Westw., Gen. Diurn. Lep. 426: the same.

Bates and Kirby use it similarly. See Dorila.

1004. Tachyris.

1867. Wall., Trans. Ent. Soc. Lond. [3] iv. 361: I. Hombronii, Cardena, Nerissa, Lyncida (Lynceola, Lyncida, formosana, Andrea, Hippo), Enarete, Scyllara (Scyllaria), Ada (Ada, Clavis), abnormis, Panda (Panda, Nathalis), Paulina, Albina (Rouxii), Psyche, Galathea, Ega, Urania, Agave (Jacquinotii), Alope, Amarella, Acrisa, Leptis; II. Celestina, Clementina, Athama, Cynisca, Eumelis, Panthea, Cycinna, Corinna, Liberia, Eliada, Placidia, Fatime (Fatima); III. **Nero** (Nero, Domitia), Galba, Zarinda, bournensis, Zamboanga, Asterope, Ithome, Nephele; IV. Pandione, Lucasii, Indra, Phœbe, Nephele (Zamora), Lalage (Lalago); V. Polisina, Ægis (Illana).

1871. Kirb., Syn. Cat. 463: uses it in the same sense.

Nero may be taken as the type. See Trigonia.

1005. Tænaris.

1816. Hübn., Verz. 53: **Urania** (Jaira, Nysa). Sole species, and therefore type.

1865. Herr.-Schaeff., Prodr. 71: employs it for the same and many others.

1871. Kirb., Syn. Cat. 117 [Tenaris*]: follows Herrich-Schaeffer.

See also Drusilla.

1006. Tagiades.

1816. Hübn., Verz. 108: **Japetus**, Paulinus.

1869. Butl., Cat. Fabr. Lep. 283: employs it for four species, including none of Hübner's.

* The word is given in four different ways in Hübner's Verzeichniss: Tænares and its German equivalent Tänaren at the head of the group, where the names are always given in the plural form; Tenaris, in connection with the species; and Tænaris, in the index. This, as well as the derivation of the word, shows that Tenaris was simply a misprint.

1870. Ib., Ent. Monthl. Mag. vii. 99: specifies Japetus as type.
1871. Kirb., Syn. Cat. 634: employs it for both Hübner's species and many others.

1007. Talides.

1816. Hübn., Verz. 106: Athenion, Corbulo (obscurus), **Sergestus** (Sinois), Broteas, Astylos, Celænus, Ramusis.
1869. Butl., Cat. Fabr. Lep. 266: employs it for Nicias, Phocus, Sergestus (Sinon), and Sebaldus, the third of them only one of Hübner's, and therefore type.
1870. Ib., Ent. Monthl. Mag. vii. 93: specifies Athenion as type, but wrongly; his own previous action having determined that Sergestus must be the type, the two species not being strictly congeneric.

1008. Tamyris.

1820–21. Swains., Zoöl. Ill. i. i. 33: **Zeleucus**. Sole species, and therefore type.

Subsequently, in the same work, he added other species. See Pachyrhopala.

1009. Tanaecia.

1868. Butl., Proc. Zoöl. Soc. Lond. 610: Calliphorus, Valmikis, Apsarasa, Varuna (supercilia), Varuna, Aruna, Lutala, Trigerta, Pelea, **Pulasara** (Pulasara, Vikrama), Violaria. Pulasara is specified as type.
1871. Kirb., Syn. Cat. 257: uses it similarly.

1010. Tanaoptera.*

1820. Billb., Enum. Ins. 79: Amalthea (Amathea), Europa, Leda (Leda, Banksii).

This name may be allowed to drop, from the heterogeneous nature of the contents of the genus.

1011. Tapina.*

1820. Billb., Enum. Ins. 81: proposes this name, for no reason, to supplant Emesis. He gives no species.

1012. Taractrocera.

1869. Butl., Cat. Fabr. Lep. 279: **Mævius**. Sole species, and therefore type, as specified later by Butler, and as used by Kirby.

1013. TATOCHEILA.

1870. Butl., Cist. Ent. i. 38, 51: **Autodice** (Autodyce). Sole species and designated type.

Is this genus distinct from Pontia? See also Synchloe.

1014. TAXILA.

1847. Doubl., List Br. Mus. 2: **Haquinus** (Drupadi), Orphna, Echerius, and some MS. species.

1851. Westw., Gen. Diurn. Lep. 421: employs it for all the above and others.

1861. Hewits., Exot. Butt. ii. 91: uses it for the first two of Doubleday's species and a number of others.

1867. Bates, Jour. Linn. Soc. Lond. ix. 414: employs it for Orphna, Haquinus (Drupadi), and others.

1871. Kirb., Syn. Cat. 285: follows Bates.

Haquinus may be taken as the type.

1015. TAYGETIS.

1816. Hübn., Verz. 55: Virgilia, Andromeda (Thamyra, Andromeda), **Mermeria**, Celia.

1851. Westw., Gen. Diurn. Lep. 355: Mermeria is mentioned as "a good type of the genus," and all of Hübner's other species are included in it, besides others.

1865. Herr.-Schaeff., Prodr. i. 58: the same.

1867. Butl., Ent. Monthl. Mag. iv. 194: specifies Virgilia as type.

1871. Kirb., Syn. Cat. 108: uses it for all of Hübner's species and others.

On account of Westwood's statement, Mermeria should be considered the type.

1016. TEINOPALPUS.*

1843. Hope, Trans. Linn. Soc. Lond. xix. 131: *imperialis*. Sole species, and therefore type.

Since used for same species by Doubleday, Gray, and Kirby, but properly objected to by Felder as of mongrel origin. See Teinoprosopus.

1017. TEINOPROSOPUS.

1864. Feld., Spec. Lep. 1: **imperialis**. Sole species, and therefore type.

1867. Herr.-Schaeff., Prodr. ii. 19: the same.

Proposed by Felder to replace Teinopalpus (q. v.). "Pristinum nomen vox hybrida."

1018. TELCHIN.*

1825. Hübn., Cat. Franck, 85: *Licus* and three MS. species. Licus is therefore type.

It is given with the authority Cramer, and is doubtless meant for Castnia Lycas of Verlorens's Catalogue of Cramer.

As it is not a butterfly, we have nothing to do with it in this place.

1019. TELCHINIA.

1816. Hübn., Verz. 27: violæ (Cephea), Medea (Saronis), Cæcilia (Bendis), Zetes (Mycenæa, Zetis), Horta, **Serena,** vesta (Issoria).

1848. Doubl., Gen. Diurn. Lep. 141: employs it for a number of species, including, of Hübner's, violæ, Cæcilia, and Serena.

1857. Horsf.-Moore, Cat. Lep. E. Ind. Co. i. 135: adopt Doubleday's restriction, and employ it for violæ only.

This would therefore become the type, were it not probable that it is strictly congeneric with Horta, the type of Acræa. Serena may be chosen.

1020. TELEGONUS.

1816. Hübn., Verz. 104: Talus, Phocus (Phocus, Morpheus), **Anaphus,** Midas.

1869. Butl., Cat. Fabr. Lep. 261: employs it for all of the above, excepting Phocus, and for others.

1870. Ib., Ent. Monthl. Mag. vii. 56: specifies Talus as the type.

1871. Kirb., Syn. Cat. 572: uses it in this sense.

Talus, however, cannot be taken as the type, as it belongs to Thymele, whose type was earlier established. Anaphus may be taken as the type.

1021. TELEMIADES.

1816. Hübn., Verz. 106: **Avitus,** Epicalus, Salatis.

1869. Herr.-Schaeff., Prodr. iii. 68: employs it for Avitus and others. Avitus therefore becomes the type.

1022. TELESTO.*

1832. Boisd., Voy. Astrol. 164: *Peronii* (Perronii). Sole species, and therefore type.

1862. Feld., Verh. Zoöl.-bot. Gesellsch. Wien. xii. 491: describes three new species, recognizing Peronii as the type.

1869. Herr.-Schaeff., Prodr. iii. 53: without indication of species.

1870 Butl., Ent. Monthl. Mag. vii. 96: specifies Dirpha as type, of course erroneously.

The name is preoccupied in Polyps (Lamx. 1812) and Crustacea (Rafin. 1814). See Hesperilla.

1023. Temenis.

1816. Hübn., Verz. 34: Minerva (Arcadia), **Laothoe** (Merione), Erigone, Hedonia, Laomedia.

1871. Kirb., Syn. Cat. 204: employs it for Sylphis, pulchra, and Laothoe.

Laothoe should therefore be considered as the type.

1024. Teracolus.

1832–33. Swains., Zoöl. Ill. ii. 115: **subfasciatus.** Sole species, and therefore type, as stated by Butler.

Used in same sense by Kirby. See also Ptychopteryx and Thespia.

1025. Terias.

1820–21. Swains., Zoöl. Ill. i. 22: Elvina, **Hecabe.** Hecabe designated as type.

1836. Boisd., Spec. gén. 651: employs it for the two above-mentioned and more than fifty others.

It is similarly used by Doubleday and others.

1870. Butl., Cist. Ent. i. 35, 44: specifies Hecabe as the type.

1026. Terinos.*

1836. Boisd., Spec. gén., pl. 5 B.: *Clarissa.* Sole species, and therefore type.

Used in same sense by Doubleday, Felder, and Kirby, but the name is preoccupied through Terina (Hübn., Lep. 1816).

1027. Tetragonus.*

1832. Gey. in Hübn., Zutr. iv. 17: *Catamitus.* Sole species, and therefore type.

According to Westwood (Gen. Diurn. Lep. 504), it is not a butterfly. The name is in any case preoccupied through Tetragonum (Quoy et Gaim. 1824) and Tetragona (Ib. 1827).

1028. Tetraphlebia.

1867. Feld., Reise Novara, 487: **Germainii.** Sole species, and therefore type, as stated by Butler.

1029. Thais.

1807. Fabr., Ill. Mag. vi. 283: Polyxena (Hypsipyle). Sole species, and therefore type.

1810. Latr., Consid. 440: specifies Rumina as type, but wrongly.

1815. Oken, Lehrb. i. 726: employs it for Polyxena.
1816. Hübn., Verz. 89: employs it for both of the above.

It is subsequently used in the same sense by all authors, but is preoccupied in Mollusca (Bolt. 1798). See Zerynthia and Eugraphis.

1030. THALEROPIS.

1871. Staud., Cat. Eur. Lep. 17. **Ionia.** Sole species, and therefore type.
1871. Kirb., Syn. Cat. App. 649: the same.

1031. THANAOS.

1832–33 (either late in 1832 or early in 1833). Boisd., Icon. 240: Marloyi, **Tages.**
1833–34 (probably 1834 or late in 1833). Boisd.-LeC., Lép. Amér. Sept., pl. 65, 66: Juvenalis, Brizo.
1836. Boisd., Spec. gén., pl. 9 B.: Tages.
1870. Butl., Ent. Monthl. Mag. vii. 97: specifies Juvenalis as type, but wrongly.

Tages should be taken as the type. See Nisoniades and Erynnis.

1032. THAROPS.

1816. Hübn., Verz. 109: **Menander,** Thersander. [Placed by Hübner among the Urbicolæ!]
1847. Doubl., List Br. Mus. 14: employs it for Menander only, which thereby becomes the type.

Used in this same sense by subsequent authors.

1033. THAUMANTIS.

1822–26. Hübn., Exot. Schmett. ii.: **Odana** (Oda). Sole species, and therefore type.
1836. Boisd., Spec. gén., pl. 8 B.: the same.

Subsequently used by Doubleday, Westwood, and Kirby in the same sense.

1034. THECLA.

1807. Fabr., Ill. Mag. vi. 286: betulæ, **spini,** quercus.
1815. Oken, Lehrb. i. 721: employs it for the same and others.
1815. Leach, Edinb. Encycl. 718: uses it for betulæ, pruni (generically identical with spini), and quercus.
1821–22. Swains., Zoöl. Ill. i. ii. 69: specifies betulæ as type.

Subsequent authors have employed it for the whole body of European hair-streaks.

1829. Curtis, Brit. Ent. pl. 264: designates betulæ as the type.

1840. Westw., Gen. Syn. 88: does the same.

1872. Crotch, Cist. Ent. i. 66: says that betulæ is type, through Dalman in 1816; but Dalman specifies betulæ as type of Zephyrus, of which Aurotis was a section.

1870. Kirb., Journ. Linn. Soc. Lond. Zoöl. x. 499: says "it would be far more convenient and quite justifiable" to take spini as type.

1872. Scudd., Syst. Rev. 29: specifies spini as type.

Betulae cannot be taken as the type on account of the foundation in 1816 of Dalman's Zephyrus, and consequently spini must be chosen.

1035. Themone.

1851. Westw., Gen. Diurn. Lep. 461: **Pais.** Sole species in the typical section and designated type of the genus.

1867. Bates, Journ. Linn. Soc. Lond. ix. 425: employs it for Pais and two others.

1871. Kirb., Syn. Cat. 299: uses it in a similar manner.

1036. Theope.

1847. Doubl., List Br. Mus. 6: Lagus, **Terambus**, and some MS. species.

1851. Westw., Gen. Diurn. Lep. 439: employs it for several species, including only Terambus (Lytæa, Terambus) of Doubleday's, which thereby becomes the type.

1858. Moore, Cat. Lep. E. Ind. Co. i. 234: uses it (as new) for Himachala, an entirely different insect. See Anadebis.

1868. Bates, Journ. Linn. Soc. Lond. ix. 453: uses it for Terambus and very many others.

1871. Kirb., Syn. Cat. 330: uses it for many species, including Terambus.

See also Psalidopteris.

1037. Theorema.

1865. Hewits., Ill. Diurn. Lep. 69: **Eumenia.** Sole species, and therefore type.

Used for same species by Kirby.

1038. Thereus.

1816. Hübn., Verz. 79: **Lausus.** Sole species, and therefore type.

1039. Theritas.

1816. Hubn., Verz. 80: imperialis (Venus), **Mavors.**

1869. Butl., Cat. Fabr. Lep. 194: employs it for Actæon, with which he places imperialis (Venus).

This, therefore, would become the type, but imperialis became in 1882 the type of Arcas, leaving Mavors for the type of this group.

1040. THERIUS.*

1820. Dalm. in Billb., Enum. Ins. 75: Apollo, Mnesonyme.

The name is preoccupied through Theria (Hübn., Lep. 1816) and Thereus (Ib.). See Parnassius and Doritis.

1041. THESPIA.*

1858. Wallengr., K. Vet. Akad. Förh. xv. 77: *Bohemanni*. Sole species, and therefore type.

Doubtless intended by Wallengren to supplant his Ptychopteryx (preoccupied), but it falls before Teracolus.

1042. THESTIAS.*

1836. Boisd., Spec. gén. 590: Pyrene (Ænippe, Pirene), Marianne, Vollenhovii (Balice), Venilia.

Subsequently used by Doubleday and others, but the name is preoccupied through Thestius (Hübn., Lep. 1816). See Ixias.

1043. THESTIUS.

1816. Hübn., Verz. 78: Gabriela (Gabrielis), **Pholeus** (Pholeus, Archytes), Hyacinthus, Ematheon, Lycabas (Lycabus).

Pholeus may be taken as the type.

1044. THESTOR.

1816. Hübn., Verz. 73: **Protumnus** (Petalus), Ballus.
1857. Led., Wien. Ent. Monatschr. i. 32: employs it for Ballus and others, not including Protumnus.
1861. Staud., Cat. Lep. Eur. 3: follows Lederer.
1869. Butl., Cat. Fabr. Lep. 174: uses it for Protumnus and others.
1871. Kirb., Syn. Cat. 345: follows Lederer.

Ballus, however, cannot be taken as the type, since previously to Lederer's action it had been selected as the type of Tomares (q. v.); we must therefore follow Butler in considering Protumnus as the type.

1045. THISBE.

1816. Hübn., Verz. 24: **Irenæa** (Belise). Sole species, and therefore type.

Since used similarly by Bates and Kirby.

1046. Thoas.*

1832–33. Swains., Zoöl. Ill. 121: Hectorides (Lysithous), **Thoas**, Agavus (Agavius), Pompeius (Paris), Androgeos (Androgeus). Thoas and Agavus are specified as typical.

Since the name is founded on one of the typical species, it must drop. See Heraclides.

1047. Thorybes.

1872. Scudd., Syst. Rev. 50: **Bathyllus**, Pylades, Nevada. Bathyllus specified as type.

1048. Thracides.

1816. Hübn., Verz. 105: **Phidon**, Salius.

1869. Herr.-Schaeff., Prodr. iii. 44: employs the name, but without specification. Kirby (Syn. Cat. 624) credits him with placing here some of the species of Butleria Kirby, none of which are older than 1852.

1871. Kirb., Syn. Cat. 578: uses it for both of Hübner's species and for others.

Phidon may be taken as the type.

1049. Threnodes.*

1870. Hewits., Equat. Lep. iv. 58: *Cænoides*. Sole species, and therefore type.

1871. Kirb., Syn. Cat. 306: the same.

The name is preoccupied in Lepidoptera (Duponch. 1844.). See Nahida.

1050. Thyca.

1858. Wallengr., K. Vet. Akad. Förh. xv. 76: I. Hyparete, Egialea; II. **Aganippe.**

1869. Butl., Cat. Fabr. Lep. 205: employs it for the species in Wallengren's first section, and for others.

But these must be placed in Delias, and consequently Aganippe must be taken as the type.

1051. Thymele.

1807. Fabr., Ill. Mag. vi. 287: I. Proteus, **Mercatus**, Apastus (Acastus); II. Thrax, Gnetus, Bixæ; III. Morpheus (Aracinthus), malvæ, Tages.

1815. Oken, Lehrb. i. 758: employs it for Proteus, Mercatus, Apastus (Acastus), and others not mentioned by Fabricius.

1828. Steph., Ill. Brit. Ent. Haust. i. 97: restricts it to malvæ, Tages, and others not mentioned by Fabricius.
1840. Westw., Gen. Syn. 88: specifies Tages as type.
1871. Kirb., Syn. Cat. 569: Proteus and its immediate allies.
1872. Scudd., Syst. Rev. 47: specifies Proteus as type.

Proteus, however, cannot be taken as type; for in 1832 it became the type of Eudamus. By Oken's action the genus must be restricted to Fabricius's first section after the removal of Proteus, and Mercatus may be taken as the type.

1052. Thymelicus.

1816. Hübn., Verz. 113: Actæon, Pustula, **Vibex**, Thaumas (Venula, linea), lineola (Virgula), Vitellius, Numitor (Puer).
1850. Steph., Cat. Brit. Lep. 22: employs it for Actæon and Thaumas (linea).
1858. Kirb., List Brit. Rhop. [Thymelinus]: uses it for Actæon only.
1869. Herr.-Schaeff., Prodr. iii. 44: uses it without specification of members.
1870. Butl., Ent. Monthl. Mag. vii. 94: specifies Actæon as type.
1871. Kirb., Syn. Cat. 609: uses it in this sense.
1872. Scudd., Syst. Rev. 54: specifies Actæon as type.

Thaumas, however, is the type of Adopæa, and Actæon and lineola belong to the same genus. Vitellius belongs to Atrytone (1872), and Numitor is the type of Ancyloxypha (1862). Pustula and Vibex remain: these belong to Hedone (1872), which may fall before this name. Vibex may be taken as the type.

1053. Thyridia.

1816. Hübn., Verz. 9: Themisto, **Psidii**, Ilione.
1844. Doubl., List Br. Mus. 59: employs it for the same and others.
1847. Ib., Gen. Diurn. Lep. 117: uses it for Psidii and Ædesia.
1862. Bates, Linn. Trans. xxiii. 519: employs it for Pytho (Ino) only.
1864. Herr.-Schaeff., Prodr. i. 47: employs it for several, including only Psidii of Hübner's list.
1870. Boisd., Lép. Guat. 30: employs it for Eupompe, etc. See his Xanthocleis for this group.
1871. Kirb., Syn. Cat. 19: uses it for Themisto, Psidii, and others not of Hübner's list.

Psidii becomes the type by Doubleday's action in 1847.

1054. Thysonotis.

1816. Hübn., Verz. 20: **Danis**, Athemon (Athemæna).

1860. Feld., Wien. Ent. Monatschr. iv. 224: employs it (as new?) for Inops and others related to Danis.

Athemon is the type of Eubagis, and Danis may be taken as the type. See Damis and Danis.

1055. Tigridia.

1816. Hübn., Verz. 40: **Aceste**, Dirce, Zingha.

1844. Doubl., List Br. Mus. 93: employs it for Aceste only, which therefore becomes the type.

See Callizona.

1056. Timetes.

? 1836. Boisd. in Cuv., Règne An. Ed. Disc. ii., pl. 139 [Tymetes]: **Merops.** Sole species, and therefore type.

1844. Doubl., List Br. Mus. i. 87: Coresia, Themistocles, Chiron, Orsilochus, Corinna, and some unpublished species.

1850. Westw., Gen. Diurn. Lep. 262: employs it for all the above and for others.

1870. Boisd., Lép. Guat. 44: uses it for Corinna and others.

1057. Tingra.

1847. Boisd., Voy. Deleg. ii. 589: **tropicalis.** Sole species, and therefore type.

1852. Westw., Gen. Diurn. Lep. 504: refers to it as probably allied to Pentila.

1857. Wallengr., Rhop. Caffr. 46: the same.

See Pentila and Liptena.

1058. Tisiphone.

1816. Hübn., Verz. 60: **Abeona** (Zelinde), Pasiphae (Pasyphae), Tulbaghia (Tulbachii).

1822–26. Ib., Exot. Schmett. ii.: Hercyna.

1844. Doubl., List Br. Mus. 150: Hercyna.

1851. Westw., Gen. Diurn. Lep. 370: the same.

1865. Herr.-Schaeff., Prodr. i. 61: Hercyna and another.

1868. Butl., Ent. Monthl. Mag. iv. 194: specifies Hercyna as type.

1868. Ib., Cat. Sat. 71: the same; but refers the genus to Westwood, and adds in a note that Abeona is the type of Hübner's Tisiphone.

1871. Kirb., Syn. Cat. 46: Hercyna. He queries which of Hübner's references is the older, but there can be little doubt upon the point, thanks to Hübner's Index.

Hercyna cannot be taken as the type, as it is not congeneric with any of the species upon which the genus was founded, nor is it one of the original list. Tulbaghia became type of Meneris in 1844. Pasiphae belongs to Pyronia (1816), so that Abeona must be taken as the type. See also Heteronympha and Hipparchioides.

1059. Tithorea.

1847 (June). Doubl., Gen. Diurn. Lep., pl. 14: Bonplandi, **Harmonia** (Megara).

1847 (Aug.). Ib., ib. 99: I. Humboldtii, Bonplandi, Pavonii; II. Irene, Harmonia (Megara), Tyro.

1862. Bates, Linn. Trans. xxiii. 552: employs it for Harmonia and a new species.

1864. Herr.-Schaeff., Prodr. i. 50: uses it much as Doubleday did.

1871. Kirb., Syn. Cat. 35: the same.

Harmonia is the type through Bates.

1060. Tmetoglene.

1862. Feld., Wien. Ent. Monatschr. vi. 235. **Esthema.** Sole species, and therefore type.

Used in same way by Bates, Herrich-Schaeffer, and Kirby. See Brachyglenis.

1061. Tmolus.

1816. Hübn., Verz. 76: Megacles, Sylvanus (Syllidus), Crolus, **Echion**, Eurytulus.

1869. Butl., Cat. Fabr. Lep. 187: employs it for Echion and several others not specified by Hübner.

Echion therefore becomes the type.

1062. Tomares.

1839. Ramb., Faune Ent. Andal. ii. 261: **Ballus.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 345 [Thomares]: given as a synonyme of Thestor (q. v.).

1063. Trapezites.

1816. Hübn., Verz. 112: **Symmomus.** Sole species, and therefore type, as stated by Butler.

1869. Herr.-Schaeff., Prodr. iii. 49: used without mention of species.

1871. Kirb., Syn. Cat. 621: used in same sense.

1064. TREPSICHROIS.

1816. Hübn., Verz. 16: **Midamus** (Basilissa, Mulcibra, Midamis), Alca, Eleusina.

Midamus may be taken as the type.

1065. TRICHONIS.

1865. Hewits., Ill. Diurn. Lep. 68: **Theanus.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 427: the same.

1066. TRIGONIA.*

1837. Gey. in Hübn., Zutr. v. 21: *Nero.* Sole species, and therefore type.

The name is preoccupied in Mollusks (Brug. 1791). See Tachyris.

1067. TRIOPADES.

1816. Hübn., Verz. 73: Orus, **Eupalemon.**

Eupalemon may be taken as the type. This species is wrongly placed by Kirby among the Urbicolæ.

1068. TRIPHYSA.

1850. Zell., Stett. Ent. Zeit. 308: Dohrnii, **Phryne** (Tircis).

1861. Staud., Cat. 14: employs it for Phryne and Sunbecca.

1865. Herr.-Schaeff., Prodr. i. 60: the same.

1867. Butl., Ent. Monthl. Mag. iv. 194: designates Phryne as the type.

Is this name too close to Triphassa (Hübn., Lep. 1816) to be used? See Phryne.

1069. TRITONIA.*

1832. Gey. in Hübn., Zutr. iv. 25: *Eupompe.* Sole species, and therefore type.

This name is preoccupied in Mollusks (Cuv. 1798).

1070. TROIDES.

1816. Hübn., Verz. 88: Priamus, **Helena** (Amphimedon, Helena), Pompeus (Astenous, Minos), Amphrysus, Hippolytus (Remus).

Helena may be taken as the type. See Amphrisius.

1071. TROILIDES.

1822–26. Hübn., Exot. Schmett. ii: **Torquatus** (Tros). Sole species, and therefore type.

1072. TYANITIS.*

1847. Doubl., List Br. Mus. 19: *Tenes.* Sole species, but undescribed.

The genus also being undescribed, the name falls.

1073. UDRANOMIA.*

1870. Butl., Ent. Monthl. Mag. vii. 58: *Orcinus.* Sole species, and designated type.

1871. Kirb., Syn. Cat. 579: the same.

See Hydrænomia, which supplants it on orthographic grounds.

1074. URANEIS.

1867. Bates, Journ. Linn. Soc. Lond. ix. 411: **hyalina.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 333: the same.

Is this name too close to Urania (Fabr., Lep. 1807).

1075. URBANUS.

1806. Hübn., Tent. 1: **alceæ** (malvæ).* Sole species, and therefore type.

See Carcharodus, Erynnis, and Spilothyrus.

1076. UTICA.

1865. Hewits., Ill. Diurn. Lep. 56: **Onycha.** Sole species, and therefore type.

Thus used by Kirby. Preoccupied in Crustacea (White-Ad. 1847).

1077. VALERIA.*

1829. Horsf., Descr. Cat. Lep. E. Ind. Co. 139: *Valeria.* Sole species, and therefore type.

The name, being founded on that of the sole species, falls.

1078. VANESSA.

1807. Fabr., Ill. Mag. vi. 281: Io, **Atalanta,** urticæ, Levana.

1810. Latr., Consid. 440: specifies Atalanta as type.

1815. Oken, Lehrb. i. 729: employs it for Arsinoe and others.

1816. Hübn., Verz. 33: uses it for Huntera (Hunteri), Carye, and cardui.

1825. Curtis, Brit. Ent., pl. 96: designates Atalanta as type.

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* Kirby (Syn. Cat. 612) strangely gives Hübner's malvæ (Eur. Schmett. 450-1) as a synonyme of sidæ, and not of alceæ.

1837. Sodoffsk., Bull. Mosc. x. 80: proposes to change the spelling of the name to Phanessa.

1840. Westw., Gen. Syn. 87: specifies Io as type.

1848. Doubl., Gen. Diurn. Lep. 98: Io, urticæ, and others.

1861. Feld., Neues Lep. 12: divides the group into five sections, placing urticæ in the third and Io in the fifth.

1871. Kirb., Syn. Cat. 181: employs it in Doubleday's sense, but subsequently (p. 648) treats it as a synonyme of Nymphalis.

1872. Scudd., Syst. Rev. 21: specifies Atalanta as type.

1872. Crotch, Cist. Ent. i. 66: would drop the name as synonymous with Nymphalis.

See Ammiralis, Bassaris, Pyrameis, and Cynthia.

1079. Victorina.

1840. Blanch., Hist. Ins. iii. 447: **Steneles.** Sole species, and therefore type.

Subsequently used in same sense by Doubleday, Westwood, Felder, and Kirby.

1080. Vila.

1871. Kirb., Syn. Cat. 217: **Azeca**, Mariana, Emilia, Stalachtoides.

1873. Ib., Zoöl. Rec. for 1871, 360: specifies Azeca as type, that having been the type of Olina, which this name is intended to supplant.

1081. Xanthidia.

1829–30. Boisd.-LeC., Lép. Am. Sept. 48: Delia, jucunda, Lisa, **Nicippe.**

1832. Boisd., Voy. Astrol. 59: Smilax, puella.

1833. Ib., Ann. Mus. Hist. Nat. ii. 168; Brigitta (pulchella) and others.

Delia, with which jucunda and Lisa are strictly congeneric, was taken in 1870 as type of Eurema (1816), so that Nicippe must be taken as the type of Xanthidia. See also Abœis.

1082. Xanthocleis.

1870. Boisd., Lép. Guat. 30: Psidii, Themisto, **Ædesia** (Ædessa), and a MS. species.

Psidii and Themisto are congeneric but distinct from Ædesia; and Psidii is already the type of Thyridia; so that Ædesia must be taken as the type. See Aprotopos.

1083. XANTHOTÆNIA.

1857. Westw., Trans. Ent. Soc. Lond. [N. S.] iv. 187: **Busiris.** Sole species, and therefore type.

1871. Kirb., Syn. Cat. 238: the same.

1084. XENANDRA.

1865. Feld., Reise Novara, 304: **Heliodes.** Sole species, and therefore type.

1867. Bates, Journ. Linn. Soc. Lond. ix. 427: Helius, Heliodes (Helioides).

1871. Kirb., Syn. Cat. 301: the same.

1085. XENICA.

1851. Westw., Gen. Diurn. Lep. ii. 387: **Achanta,** Klugii (Singa), Abeona, Lathoniella.

1858. Horsf.-Moore, Cat. Lep. E. Ind. Co. i. 228: employ it for Achanta only, which thereby becomes the type.

1867. Butl., Ent. Monthl. Mag. iii. 279: Abeona and Joanna.

1868. Ib., Cat. Sat. 70: specifies Abeona as type. See Heteronympha.

1871. Kirb., Syn. Cat. 76: uses it for some of Westwood's species and others, not including either of Butler's.

See Geitoneura.

1086. XOIS.

1865. Hewits., Trans. Ent. Soc. Lond. [3] ii. 282: **Sesara.** Sole species, and therefore type, as stated by Butler and used by Kirby.

1087. YPHTHIMA.

1816. Hübn., Verz. 63: Cassus (Casse), Hippia, Manto, Tyndarus (Cleo), **Philomela.**

1844. Doubl., List Br. Mus. 138: employs it for Philomela and others.

1851. Westw., Gen. Diurn. Lep. 394: makes a similar use of it, so that Philomela becomes the type.

1868. Butl., Ent. Monthl. Mag. iv. 196: designates Lisandra (Philomela) as type.

1871. Kirb., Syn. Cat. 94: makes a similar use of it.

1088. ZARETIS.

1816. Hübn., Verz. 49: **Isidora,** Bisaltide (Polybete).

Isidora may be taken as the type.

1089. Zegris.

1836. Ramb., Ann. Soc. Ent. Fr. v. 581: **Eupheme.** Sole species, and therefore type.

1836. Boisd., Spec. gén. 552: employs it for the same and others.

1847. Doubl., Gen. Diurn. Lep. 52: the same.

1870. Butl., Cist. Ent. i. 39, 54: specifies Eupheme as the type.

1090. Zelima.

1807. Fabr., Ill. Mag. vi. 279: **Pylades.** Sole species, and therefore type.

1820. Billb., Enum. Ins. 81: proposes, without reason, to supplant this name by Ailus (q. v.).

1091. Zelotæa.

1867. Bates, Journ. Linn. Soc. Lond. ix. 381: **Phasma,** dubia, Achroa.

1871. Kirb., Syn. Cat. 310: the same.

Phasma may be taken as the type.

1092. Zemeros.

1836. Boisd., Spec. gén., pl. 5 C.: **Flegyas** (Allica). Sole species, and therefore type.

Used in same sense by subsequent authors.

1093. Zeonia.

1832–33. Swains., Zoöl. Ill. ii. 111: **Faunus** (Heliconides). Sole species, and therefore type.

Used in same sense by Boisduval, Doubleday, Westwood, Bates, and Kirby. See Chorinea and Rodinia.

1094. Zephyrus.

1816. Dalm., Vetensk. Acad. Handl. xxxvii. 62, 90: all the species quoted under Aurotis, Heodes, and Cyaniris (q. v.), these being the three sections into which he divides this group. **Betulæ** is specified as the type.

1820. Dalm. in Billb., Enum. Ins. 80 [Zephyrius]: employs it for betulæ and others.

1832. Gray, Griff. An. Kingd., pl. 58 [Zephyrius]: uses it for Amor.

1842–44. Guér., Iconogr. Règne An. 490, pl. 81 [Zephyrius]: the same.

1853. Wallengr., Rhop. Scand. 178: employs it for quercus and betulæ.

1871. Kirb., Syn. Cat. 402: uses it for the same and others.

See Aurotis.

1095. Zerene.

1816. Hübn., Verz. 97: Croceus (Hyale), Erate, Hyale (Palæno), Phicomene, **Cesonia.**

1850. Steph., Cat. Brit. Lep. 3 [Xerene]: employs it for Hyale alone; but this cannot be taken as the type, since it had previously been made the type of Eurymus. See also Colotis.

1862. Scudd., Proc. Bost. Soc. Nat. Hist. ix. 103: employs it for Cesonia (Cœsonia) and Eurydice, wherefore Cesonia is type.

1872. Ib., Syst. Rev. 38: specifies Cesonia (Cæsonia) as the type.

1872. Grote, Can. Ent. iv. 215: says that this group, being synonymous with Colias, cannot be used, and that Megonostoma (q. v.) should be employed; but it is not strictly synonymous with what Grote means by Colias.

1096. Zeritis.

1836. Boisd., Spec. gén., pl. 6 C.: **Neriene.** Sole species, and therefore type.

1847. Doubl., List Br. Mus. 56: employs it for the allied species Thero, and for others, but not for Neriene.

1849. Luc., Expl. Alg. Zoöl. iii., pl. 1: Siphax, a wholly different insect. See Cigaritis.

1852. Westw., Gen. Diurn. Lep. 500: uses it for fourteen species, among them Neriene and Thero.

1857. Wallengr., Rhop. Caffr. 46 [Zerythis]: uses it for Protumnus (Basuta).

The name is very close to Zaretis (Hübn., Lep. 1816).

1097. Zerynthia.

1816. Ochs., Schmett. Eur. iv. 29: **Polyxena,** Rumina (Medesicaste, Rumina).

1822–26. Hübn., Exot. Schmett. ii.: uses it for Ogina, an entirely different insect.

1835, Herr.-Schaeff., Nomencl. Ent. i. 4: employs it in Ochsenheimer's sense.

1837. Sodoffsk., Bull. Mosc. x. 82: suggests that it should be spelled Zerinthia.

Polyxena may be taken as type. See also Eugraphis and Thais.

1098. Zesius.

1816. Hübn., Verz. 77: Phæomallus, **Chrysomallus.**

Chrysomallus may be taken as the type.

1099. Zethera.

1861. Boisd. in Feld., Neues Lep. 26: **Pimplea.** Sole species, and therefore type, as stated by Butler.

1871. Kirb., Syn. Cat. 45: employs it in the same sense.

See Amechania.

1100. Zetides.

1816. Hübn., Verz. 85: **Sarpedon,** Eurypylus, Ægistus.

Sarpedon may be taken as the type. See Chlorisses.

1101. Zeuxidia.

1822–26. Hübn., Exot. Schmett. ii.: **Luxerii.** Sole species, and therefore type.

1844. Doubl., List Br. Mus. 114: the same.

1851. Westw., Gen. Diurn. Lep. 327: the same and others. Westwood gives Aglaura Boisd. MS. as a generic synonyme.

1871. Kirb., Syn. Cat. 115: uses it in the same sense.

1102. Zipætis.

1863. Hewits., Exot. Butt. iii. 100: **Saitis,** Scylax.

1865. Herr.-Schaeff., Prodr. i. 63: the same.

1868. Butl., Ent. Monthl. Mag. iv. 194; Cat. Sat. 98: specifies **Saitis** as type.

1103. Zonaga.

1820. Billb., Enum. Ins. 78: **Biblis.** Sole species, and therefore type.

See Didonis and Biblis.

1104. Zophoessa.

1849. Doubl., Gen. Diurn. Lep. pl. 61: **Sura.** Sole species, and therefore type.

1851. Westw., Gen. Diurn. Lep. 362: the same.

1868. Butl., Ent. Monthl. Mag. iv. 195; Cat. Sat. 108: specifies Sura as type.

1871. Kirb., Syn. Cat. 40: employs it in the same sense.

The following species of butterflies, mentioned as types of genera, were unpublished at the time of the issue of Kirby's Catalogue:—

Thaidina, of	Armandia (Blanch.), 1871.	Poweshiek, of	Oarisma (Scudd.), 1872
tractipennis,	Arteurotia (Butl.-Druce), 1872.	[oolitica,	Palæontina (Butl.), 1873.]
Lidderdali,	Bhutanitis (Atkins.), 1873.	Leda,	Periplysia (Gerst.), 1871.
Juventus,	Callimormus (Scudd.), 1872.	Aetta,	Pteronymia (Butl.-Druce), 1872.
Leonata,	Drucina (Butl.), 1872.	Reynesii,	Satyrites (Scudd.), 1872.
Darwinia,	Mimacræa (Butl.), 1872.	Hermina,	Scalidoneura (Butl.), 1871.

ADDENDA. — (March, 1875.)

46. Alcidis. — This name was introduced by an accidental error. Liris is not a butterfly, and was not given as one by Felder.

152. Aurotis. — Add: 1835. Vill.-Guén., Lép. Eur. 36: employs it for roboris (Evippus). — 1862. Kirb., Man. Eur. Butt. 87: roboris.

256 *bis*. Chortobius.*

1859. [Guén. in] Doubl, List Brit. Lep. Ed. 2: Typhon (Davus), Pamphilus. Fide Kirby in litt. Falls before Coenonympha.

302. Cupido. — Add: 1870. Kirb., Journ. Linn. Soc. Zoöl. x. 499: says, "The true type appears to be Alsus;" because, he writes me in explanation, "Schrank confounds Alsus and Argiades as sexes under his Puer," the name Puer being presumed to have suggested Cupido; but this seems to me rather strained.

305. Cyaniris. — Add: 1835. Vill.-Guén., Lép. Eur. 19: employ it for Corydon, Argiolus, and others.

492. Hæmonides. — Mr. Kirby writes me: "Cramer figures two species as Cronis, one a Castnian, the other a Pierid. Boisduval and I take this to be a case of mimicry; but Butler considers both figures to represent the Castnian."

510. Heliochroma. — 1870. Butl., Lep. Exot. 70: says, "The genus Heliochroma will, I think, have to sink into a section of Hesperocharis. I can find no constant structural characters by which to separate it."

581. Ithomia. — With regard to the text of Hübner's Sammlung exotischer Schmetterlinge, it may be remarked that the twelve species described in it are all figured in the first volume, and all referred to in the Index of 244 plates. And inasmuch as in every case of alteration of the specific name, the Index is followed, we may conclude the text of the Sammlung to be posterior to, or most probably nearly synchronous with, the Index, namely, 1822. The genus in which Dianasa is placed is spelled Eicides, as in the Index, and not Eueides as in the Verzeichniss; and further proof that it is later than the Verzeichniss is found in the entire absence of one of the species (and its generic name) from the latter, — Heliochlaena Leucosia.

633. Limenitis. — Mr. Kirby writes me that the Camilla of early British authors is not that of Fabricius, and cannot therefore be taken as type. But inasmuch as it was a strictly congeneric insect (Sibylla), the question is not affected by this fact.

755 *bis*. Nympha.*

1838–9. Krause, Faun. Thur., wrapper parts 4, 5: proposes it to include all the European Nymphales. Mr. Kirby, from whom this information is derived, appears sometimes to write it Nympha, sometimes Nymphæ. The latter form would be inadmissible in a generic name, and is also given earlier by Borkhausen (Eur. Schmett., Einl. xvii.) as a name for the whole family. Mr. Kirby adds: "On p. 85, *populi* is clearly, as I think, indicated as type." In that case the name would fall before Najas.

861. Phrissura. — Add: 1871. Butl., Trans. Ent. Soc. Lond. 171: says the insect upon which he intended to found this genus was Ægis (Illana), which at the time he wrongly identified as Cynis.

VI.

ON THE WIDE DIFFUSION OF VANADIUM AND ITS ASSOCIATION WITH PHOSPHORUS IN MANY ROCKS.

By A. A. Hayes, M.D.

Presented, Jan. 12, 1875.

Christian Keferstein, as early as 1834, had boldly stated the proposition that "all crystalline non-stratified rocks, from granite to lava, are products of the transformation of sedimentary strata," and later researches aid in confirming the truthfulness of this view.

Simply considered, all rocks consist of a basis material, generally simple minerals, such as compound silicates, aluminates, or even quartz, in various states of division, united by a compound which acts the part of a cement, which through its composition is more easily acted on by ordinary agents than the particles of the mineral it unites.

This part of every rock engages attention, also, from its acting as a positive compound does in a simple mineral. It is complex in composition, usually it consists of silicates of protoxide bases. At one moment of time it binds the particles with great force; at another, under altered conditions, it relaxes its bonds, itself losing cohesion, crumbling and becoming an earth containing the elements necessary to vegetation, while the bonded materials drop to their condition before union.

Accepting Keferstein's expression in its fullest sense, I have applied the resources of analysis to a large number of rock aggregates, and the results of my experiments have shown the interest and extent of this field of inquiry. To do this, I have departed from the ordinary course of analysis, and applied a principle which, many years since, enabled me accurately to separate alkalies from mineral compounds. This principle is the adaptation of a definite mixture of agents, so that while one part of the mixture is searching for and dissolving the substance to be studied, the other part is holding in a semi-fluid state the larger part of the substance and allowing any reactions or

adjustments of composition to take place. The subsequent solution and boiling determines the precipitation of compounds not soluble in the medium. This medium is subsequently decomposed and products divided.

MODE OF ANALYSIS.

The rock perfectly cleansed by washing and brushing, reduced to fine powder, is either dried for its combined water or taken in its natural state. A flux is prepared by melting 202 parts of potassic nitrate with 53 parts of sodic carbonate, both pure. The cooled mass, reduced to powder, absorbs about 0.004 parts when exposed to the air, and must be kept in a closed bottle. This *basis* flux can be adapted to meet all cases of varied composition in minerals. 1 grm. of the rock or mineral is mixed intimately with 1.28 grm. or 2 grms. of this flux in a tall, narrow crucible of platinum, on which no action is exerted. The crucible, covered, is heated over an ordinary Bunsen table lamp, gently while intumescence continues: the heat increased, hissing ceases, a slow sintering follows, and in 12 to 20 minutes the action is over, about one-half the whole power of the lamp being used.

The fused mass, mostly removed from the crucible by a looped platinum wire, with the crucible and cover are boiled in water. The basic silicates, more or less altered, remain; the soluble compounds dissolve, and the filtered solutious and washings, making 40 to 50 CC., are evaporated in a platinum basin to about 6 CC. To the hot solution, ammonic chloride, a little in excess of the equivalent of sodic carbonate used, is added, from a titrated pure solution, the basin put on a water-bath, the contents evaporated, and carefully dried at temperature not exceeding 100° C. After the addition of the ammonic chloride, the silicic acid gelatinizes, and, in drying, passes out of combination with the alkalies. By subsequent boiling in water and filtration, the precipitated silicic compounds are obtained.

The filtrate and washings contain other combinations, which can be treated either in the normal state of acid ammonic salts, or after the addition of a drop of ammonic hydrate renders the solution neutral to test-paper. Numerous cases occur, rendering modifications necessary. Chlorine, bromine, iodine, sulphur, compel a choice of ammonic salts. Many of the acid-forming metals are separated by their characteristic reactions, from the residue of fusion. In general, if the solution of the result of fusion does not deposit silicic acid on the addition of an ammonic salt, 0.25 grm. of silicic acid, with or without its equivalent of sodic carbonate, is added; because the displacement of other acids

depends on the presence of an excess of silicic acid. The solution containing nitrites is delicately balanced, but it is always adapted to the statical determination of phosphoric acid by the magnesia mixture, or its estimation volumetrically, in using uranic nitrate. The quantity of phosphoric acid present in mineral or artificial forms of compounds can thus be accurately obtained, and the most compact aggregates do not resist solution.

WIDE DISTRIBUTION OF PHOSPHORUS.

In applying this mode of analysis to a great variety of rocks, it soon became evident that phosphoric acid is widely distributed. In some cases, the basis, as well as the cementing part, of a rock contained it, so that adherence to the plan of seeking it in classified rocks was not possible. Associated with silicates of the more basic earths and the protoxides of metals, it is found in all the clays, the new and old lavas, trachytes, slates, — from the most fissile to the most compact, — shales, ashes of coals; in the rocks formed of quartz, feldspar, and mica; in aggregates where feldspar is replaced by quartzite, and in those containing chlorite. The well-known conglomerates of Roxbury, and a silicious slate reposing near it, contain phosphates.

In the opaque feldspars, the ancient porphyries of Rome and Carthage, phosphates occur; but the glassy and rose-colored varieties have not afforded it. The lepidolite of Paris, Me., contains it; furnace products, slags from copper and zinc, afford it. This list might be extended, without indicating any law relating to the affinities, which may perhaps be discovered as the observations are multiplied. We have in phosphatic salts in rocks another consolidating material, and an element of change.

VANADIUM ASSOCIATED WITH PHOSPHORUS.

In many of the analyses made after the method described, another acid was found associated with phosphoric acid, and this was easily proved to be a compound of *vanadium*. The frequency of its occurrence as acid or oxide, its well-marked characters as a changeful body, the colors of its compounds and mixtures, give great interest to this discovery. Owing to its association with proto salts of manganese and iron in rocks, it proves to be active, first as a binding, and secondly as a disintegrating, agent. It is a matter of surprise that the dissemination of vanadium has not before been noted, especially since its later classification with phosphorus leads to such a conclusion.

When the rocks treated by the above method for phosphoric acid contain manganic compounds, if the second filtrate, balanced by am-

monic salts, has any yellow tint, vanadic acid salts are almost surely present. It occurs with phosphoric acid in most of the mineral bodies named above. The physical character of color of the rock is the only indication I now know. The green and plum colors of slates and porphyries; the greenish epidote color of many aggregates; the changed colors, seen in sandstones, and especially in roofing slates, from worldwide localities, are guiding marks merely. My observations have been quite numerous, and as yet no proper *ore* of vanadium has been found, but sources of economical separation have been suggested.

As vanadium occurs in many well-trodden paths, I deemed it important to devise a direct way of obtaining it, in which no metal and the fewest reagents are employed.

PROCESS.

Crush in the diamond mortar 1 to 1½ grms. of greenish slate to a fine and coarse powder; place in a watch crystal, and wet thoroughly with a solution of one-fourth sulphuric hydrate, leaving a little excess. Expose freely to dry, warm air,—sunshine, if possible; and, if the slate is acted on, after 2 to 4 days, when the mass is nearly dry, the salts formed crystallize. Under a lens, a number of green or bluish-black spherical crystalline aggregates, unlike any other matter present, will be seen. These are a double salt, in which blue oxide of vanadium exists; and from such a small weight, often, enough crystals can be picked out for showing the characters of vanadium compounds. It is best to use several differing specimens, which by their colors indicate proto-silicates, and to be sure that they have been carefully washed, as granites are often invested with a lichen of a hemispherical form. One is often surprised to see the number of these crystals extruded from the mass of salt, and formed under constraint. The oxidized rocks do not afford these crystals, but we see bands of yellow vanadium compounds, denoting the condition of the substance.

The ordinary tests of vanadium are best applied to the vanadates, and among them the gall test is delicate and discriminating. If the greenish-black precipitate it forms in acid solutions be burned, the insoluble oxide obtained (when the precipitate is entirely free from any chloride) has characteristic reactions with acids, and in the blowpipe flame with fluxes. The salts of vanadium in mixture with manganous salts, precipitated by excess of ammonic hydrate, afford a blue solution above the oxides, rivalling that of cupric oxide.

By oxidizing the blackish-blue salt obtained by sulphuric hydrate, the yellow compounds form, and may be tested under both modifications.

The vanadate of ammonia present in the balanced solution from the silicates, by the mode of analysis described above, may be separated by over-saturating the solution with ammonic chloride, when ammonic vanadate separates; although phosphoric acid is present. From the vanadate other combinations of vanadium may be formed. The solution does not then respond to the gall test; and the ammonic vanadate separated, when heated, leaves vanadic acid. The deposit caused by tinct. galls may be calcined for VO^2. In testing for phosphoric acid, in this mixed solution, the magnesia mixture does not respond at once, unless the device of Wollaston be used; and, in strong solutions, plumose vanadates form. If heat is applied to the salts in mixture with chlorides, much of the vanadium will be lost. In most of the rocks containing phosphorus, vanadium has been found associated. Manganese is also a congener; and, without repeating here the list of rocks, I can promise in a future paper to give a tabulated series.

In Utah, in the Tintic District, there is a chalcedonic rock, with brown ferric and cupric ore. In the brown part of this ore both phosphorus and vanadium are abundant. The presence of vanadium, in crusts on copper rock of Lake Superior, announced some years since, by my late friend, J. E. Teschemacher, has been lately confirmed. It is present in light grayish earth-like substance of the datholite beds in the Calumet and Hecla mines. At present it appears that vanadium is as common a constituent of rocks as manganese.

VANADIC COMPOUNDS IN WATER.

The beautiful suburb of Boston, Brookline, owes its varied surface and scenic effect largely to *water action* in forming the gravel drift into elevations and depressions, having curved and graceful lines. This drift presents us with a magazine of rock aggregates, which not only supply the laboratory, but, in various cuttings, allow us to watch the influence of air, frost, and water on the rocks; which, stable in their beds, become changed, even rapidly, on exposure to these agencies. This gravel, permeated by air, changing under every variation of pressure, is powerfully oxidizing; and the rain water, even if colored on entering it, becomes colorless and sparkling at eight yards below the surface. The gravel contains strata and inclined dykes of extremely finely divided micaceous earth, or "quicksand," in which the water circulates and passes to the ocean at different levels. An *average* result of partial analyses is: 1 litre affords by evaporation and drying at 100° 0.350 grm., of this amount 0.182 grm. is nearly insoluble matter; 0.168 grm. again dissolves in water, and contains, besides the

ordinary salts, soluble silicates, not altered by boiling, drying, or heat of 100° C. These waters attack crystal glass, leaving an incrustation, which resists weak acids; and they seem to be free to act in re-consolidating strata. Indeed, in the deep parts of the gravel deposits, we meet with masses of rock in which solution of the silicates in water is hourly going on; and we may follow these solutions to the wells, and observe that sometimes depositions are formed on the surfaces of the rocks, over which they pass.

Vanadium exists in the water, which supplies the wells of the district of the drift, as a transparent, colorless solution of magnesian calcic, manganous, and ferrous silioates, phosphates, carbonates, and vanadates.

The deposit which forms in the boiling water resembles in composition the matter as taken from rocks by weak solvents, although some of these compounds remain dissolved in the water after it has been boiled.

Detection of vanadium as oxide is easily and at once effected, by dissolving the deposit formed from boiling water, by means of diluted nitric or sulphuric hydrate. In this solution, the addition of a slight excess of ammonic hydrate, and a moment after a considerable excess of ammonic carbonate, insures the reduction of any vanadic compound, by the manganous and ferrous oxides, and separation of other compounds than magnesic oxide and the blue vanadous oxide, which appears in solution of a rich blue color. In a nearly closed vessel, a bright strip of zinc will withdraw vanadous oxide from the blue solution, at first as a thin bronze coating, then after a black crust.

I believe this is the first discovery of vanadic compounds in water. Before announcing it, every source of error has been scanned; and the labor of connecting the compounds with the rocks where they originate has been performed, as necessary to completeness, in the evidence.

Manganous salts have been observed in waters where humic acid has acted on rocks containing manganous carbonate, and the existence of a water of this kind is known to me; but it must be considered quite apart in composition from a water in which soluble silicates include manganous silicate as part of a compound possessing novel characters.

In concluding this brief account of results proving the existence of phosphates and vanadic compounds in the cementing material of the most common rocks, I wish it to be considered as only introductory to a wide field of interesting research.

VII.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

No. I.

FOCI OF LENSES PLACED OBLIQUELY.

By Prof. E. C. Pickering and Dr. Chas. H. Williams.

Presented, Feb. 9, 1875.

The following experiments were suggested by noticing that the spot of light of a reflecting galvanometer was thrown out of focus when the mirror turned slightly. The image in this case was formed by a lens near the mirror; and, to obtain a distinct image, it was found that the ends of the scale must be brought much nearer the mirror, owing to the obliquity of the rays upon the lens. It was further noticed that the focus was greatly altered when the slit used was placed horizontally instead of vertically. To study the matter more carefully, the following apparatus was constructed.

To one end of a board about five feet long was fitted a small telescope; ten inches from this was placed a graduated circle, which rested horizontally on the board; and at its axis was fixed a screen of sheet iron, which stood vertically and had a hole in the centre, on a level with the telescope.

On one side of the screen, and covering the hole, was fixed a bi-convex lens of 25.5 inches focus, so placed that, when the graduated circle was moved, the lens turned about a vertical axis which coincided with that of the circle. At the farther end of the board was placed a small gas flame, and between the lens and gas was a screen which moved over a scale giving the distance in inches from the axis of the lens. At the centre of this screen, on a level with the lens, telescope, and gas flame, and in the same straight line, two fine slits were cut, one vertical the other horizontal, intersecting each other in the middle; and in these slits filaments of silk were stretched lengthwise, to aid in focussing.

To use the instrument, the gas was lighted, then the screen with the cross-hairs was placed at the principal focus of the lens: that is, 25.5

inches from it. The graduated circle, carrying the lens, was now brought to zero, so that the rays from the cross should fall normally on the centre of the lens. Lastly, the telescope was focussed on the cross-hairs. The zero point of the graduated circle was obtained with great accuracy, by lighting the gas, then, placing the eye at some distance behind the gas flame, the graduated circle was moved till the reflections from the anterior and posterior surfaces of the lens exactly coincided with the flame; in this way the true vertical as well as horizontal position was obtained. The instrument being thus adjusted, the graduated circle and lens were turned five degrees. The screen having the cross slits was now moved, by means of a rod attached to it, until the rays from the vertical slit were properly focussed by the observing telescope, the distance of the screen from the lens was read from the scale, the reading repeated three times, and the mean recorded. The same was afterward done for the rays from the horizontal slit. The graduated circle was then moved on, and the same readings repeated every five degrees. It was impossible to take readings from the vertical slit beyond 65°; for, after that, the screen could not be brought near enough to the lens to focus the rays properly, and the image became quite indistinct; but with the horizontal slit the readings were continued to 85°. After completing this set of readings, the screen was placed at one and a half times its focal length from the lens, the graduated circle brought to zero, and the telescope focussed as before; then the same readings were repeated every five degrees, also when the screen was at one half and at twice the focal distance.

Having obtained these readings, curves were constructed by the Graphical Method, the vertical distances being equal to the distance from screen to lens, and the horizontal to the angle through which the graduated circle was moved. As a test for the accuracy of the readings when the telescope was focussed for different points, all the readings were reduced, so as to be compared with those taken when the distance from lens to screen was equal to the focal length of the lens. This was done by means of the formula $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$, in which u and v are the conjugate foci, and f the principal focus of the lens. In these experiments, $\frac{1}{u}$ is a constant, for, when the telescope has been once focussed, it remains fixed through that set of readings, and the reciprocal is easily found by $\frac{1}{u} = \frac{1}{f} - \frac{1}{v}$; that is, subtracting the reciprocal of the distance from screen to lens, when the angle is equal to zero, from the reciprocal of the principal focus of the lens. This reciprocal is to be

added to those of the readings, and thus the readings of any set are rendered equivalent to those taken when the screen is at a distance from the lens equal to its principal focus. This being done, the greatest variation of any of the readings from the standard was found to be a little over one per cent.

The result of these measurements of the vertical slit are given in Table I., and of the horizontal slit in Table II. Column 1 gives the

TABLE I.

i.	.5*f.*	*f.*	1.5*f.*	2*f.*	*f.*	.5*f.*	1.5*f.*	2*f.*	Mean.
0°	12.7	25.5	88.2	51.0	25.5	25.5	25.5	25.5	25.50
5°	12.6	25.3	87.6	49.8	25.3	25.1	25.2	25 1	25.17
10°	12.3	24.8	85.6	46.5	24.8	23.9	24.8	24.8	24.20
15°	12.0	23.0	83.0	41.0	23.0	22.8	23.1	22.8	22.92
20°	11.5	21.9	30.1	37.5	21.9	21.1	21 6	21.6	21.55
25°	11.0	19.8	26.8	32.6	19.8	19.5	19.6	19.9	19.70
30°	10.2	17.7	23.0	27.0	17.7	17.1	17.7	17.7	17.55
35°	9.2	15.1	19.1	22.0	15.1	14.5	15.3	15.4	15.07
40°	8.1	12.8	15.5	17.0	12.8	11.9	12.9	12.8	12.60
45°	7.0	10.3	12.1	13.0	10.3	9.6	10.5	10.4	10.20
50°	5.7	8.1	9.2	9.5	8.1	7.3	8.2	8.0	7.90
55°	4.7	6.1	6.5	7.0	6.1	5.7	5.9	6.1	5.95
60°	3.7	4.3	4.4	4.7	4 3	4.3	4.1	4.3	4.25
65°	2.6	3.1	3.1	3.2	3.1	2.9	2.9	3.0	2.97
70°									
75°									
80°									
85°									

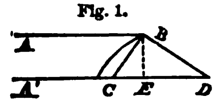
TABLE II.

i.	.5*f.*	*f.*	1.5*f.*	2*f.*	*f.*	.5*f.*	1.5*f.*	2*f.*	Mean.
0°	12.7	25.5	38.2	51.0	25.5	25.5	25.5	25.5	25.50
5°	12.8	25.4	38.1	50.5	25.4	25.9	25.5	25.4	25.55
10°	12.7	25.4	37.9	49.7	25.4	25.5	25.4	25.2	25.37
15°	12.7	25.0	37.1	48.9	25.0	25.5	25.0	25.0	25.12
20°	12.5	24.6	36.2	47.0	24.6	24.7	24.6	24.5	24.60
25°	12.4	24.0	35.1	44.7	24.0	24.8	24.1	23.8	24.05
30°	12.2	23.3	34.0	43.4	23.3	23.6	23.6	23.4	23.47
35°	12.0	22.5	32.2	41.4	22.5	22.8	22.7	22.8	22.70
40°	11.8	21.9	30.5	37.9	21.9	22.1	21.8	21.7	21.87
45°	11.5	20.9	28.9	34.7	20.9	21.1	21.0	20.7	20.92
50°	11.2	19.7	26.7	32.4	19.7	20.1	19.8	19.8	19.85
55°	10.9	18.4	25.2	30.0	18.4	19.1	19.0	18.9	18.85
60°	10.5	17.5	23.5	27.6	17.5	17.9	18.0	17.9	17.82
65°	10.1	16.6	21.5	24.7	16.6	16.8	16.8	16.7	16.72
70°	9.8	15.7	20.0	22.7	15.7	16.0	15.9	15.7	15.82
75°	9.5	14.8	18.2	20.5	14.8	15.2	14.7	14.6	14.82
80°	9.0	13.7	16.8	18.7	13.7	14.0	13.8	13.7	13.80
85°	8.6	12.8	15.3	17.0	12.8	13.0	12.8	12.8	12.85

angle of incidence, the next four columns the observed conjugate focus, u, or position of the slit when the telescope was focussed on a point seen through the lens at a distance of $.5\,f$, f, $1.5\,f$, and $2\,f$, in turn. The next four columns give the computed value of f, assuming that a lens placed obliquely conforms to the law $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$, as well as when in the ordinary position. The result justifies this assumption; for the four values of f are nearly coincident, and agree well with the mean given in the last column. The phenomena are thus greatly simplified, since we have now only to consider the case of the principal focal distances, or that the incident ray forms a parallel beam.

To represent these results theoretically, let us suppose the slits and lens so small, compared with their distance apart, that we may neglect all aberration except that due to the obliquity of the incidence. Considering first the case of the vertical slit, let Fig. 1 represent the section of a horizontal plane passing through the centre of the lens. Then let D represent the position of the slit when the emergent rays are parallel; that is, when AB is parallel to $A'C$. Now $CD=f'$ is the new focal length which is to be determined. Call f the principal focal distance, n the index of refraction, i and r the angles of incidence and refraction of the light on entering the lens, and r' and i' the corresponding angles on its emergence. Call also A the angle between the two surfaces of the lens at its edge, or of the two surfaces where pierced by the ray. Then, by the law of refraction, $\sin i = n \sin r$, and $\sin i' = n \sin r' = n \sin (r + A) = n \sin r + n\, A \cos r = \sin i + n\, A \cos r$, since $r' = A + r$ and $\sin A$ being very small may be regarded as equal to A. Again, $\sin i' - \sin i = \cos i\,(i' - i) = n\, A \cos r$, and hence, $\frac{i'-i}{A} = \frac{-n \cos r}{\cos i}$.

Fig. 1.



Now, in the triangle BCD we have $BDC = i - i' - A$, $BCD = 90 - i$, and BD sensibly equal to f'. Again, $BC = fA\,(n-1)$, for by the formula for lenses $\frac{1}{f} = (n-1)\left(\frac{1}{R}+\frac{1}{R'}\right)$, or $f = \frac{R}{2\,(n-1)}$, but $A = \frac{2\,BC}{R}$ $\therefore$ $f = \frac{BC}{A\,(n-1)}$, or $BC = fA\,(n-1)$. Since the sides are proportional to the sines of the opposite angles $BD : BC = \sin BCD : \sin BDC$, or $f' : fA\,(n-1) = \sin (90 - i) : i - i' - A$ or $f' = f.\frac{A\,(n-1) \cos i}{i - i' - A}$; dividing by A, and substituting the value of $\frac{i-i'}{A}$ given above, we have $f' = f\,\frac{(n-1)\cos^2 i}{n \cos r - \cos i} = f \cdot \frac{(n-1)\cos^2 i}{\sqrt{n^2 - \sin^2 i} - \cos i} = f \cdot$

$$\frac{(n-1)\cos^2 i}{n^2-1}\left(\sqrt{n^2-\sin^2 i}+\cos i\right)=f\,\frac{\cos^2 i}{n-1}\left(\sqrt{n^2-\sin^2 i}+\cos i\right).$$

By means of this formula, the value of f' was computed for every 5° for $n = 1.5$; and the results, calling $f = 100$, are given in column 2 of Table III. Column 1 of the same table gives the corresponding angle of incidence, and column 3 the rate of change of f for small changes of n, or $\frac{df}{dn}$. This is only serviceable if we wish to compute the foci of lenses of various indices, but it is applicable only for value of n near 1.5 or 1.6. As an example, suppose we wish the focus of a lens having an index of refraction $= 1.57$, and inclined 45°. Then $f' = 40.6 + .07 \times .6 = 41.0$. The values in column 4 are computed in this way, and give the foci for the lens actually employed, whose index was assumed to be equal to 1.55. To compare these results with observation, the last column of Table I. was reduced by dividing by 25.5, the principal focal distance. The differences or errors are given in column 6, which show the close agreement with theory. From these it appears that the deviations are probably mainly due to accidental errors, the preponderance of negative values rendering it probable that the focal distance 25.5 was taken as too small.

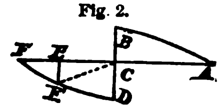
TABLE III.

i.	1.5.	$\frac{df}{dn}$	1.55.	Obs.	e.
0°	100 0	0.0	100.0	100.0	0.0
5°	98 9	0.0	98.9	98.7	—0.2
10°	96.1	0.1	96.1	94.9	—1.2
15°	91.2	0.2	91.3	89.8	—1.5
20°	84 8	0.2	84.9	84.5	—0.4
25°	77.0	0.3	77.1	77.2	+0.1
30°	68.4	0.4	68.6	68.8	+0.2
35°	59.2	0.5	59.4	59.1	—0.3
40°	49.8	0.6	50.1	50.3	+0.2
45°	40.6	0.6	40.9	40.0	—0.9
50°	32.0	0.6	32.3	31.0	—1.3
55°	24.1	0.6	24.4	23.3	—1.1
60°	17.1	0.5	17.3	16 7	—0.6
65°	11.3	0.4	11.5	11.6	+0.1
70°	7.0	0.3	7.1		
75°	3.8	0.2	4.0		
80°	1.6	0.1	1.6		
85°	0.4	0.0	.4		
90°	0.0	0.0	0.0		

The case of the horizontal slit is more complicated, since the rays no longer remain in one plane. Considering only those rays in the vertical plane passing through the axis around which the lens turns,

and one point of the slit, we see that they will strike the lens at an angle of incidence about equal to i, will traverse it in a plane which we will call the plane of refraction inclined to the first plane $i - r$, and finally emerge in a plane parallel to the first. The plane of refraction will intersect the lens along two circles whose distance apart at the centre will be greater than the thickness of the lens in the ratio of cos r to 1; hence their radii R' will be less than the radius of curvature R of the surfaces of the glass in the same ratio, or $R' = R \cos r$. Again, the apparent index of refraction n' will be different, and since $\frac{1}{f} = \frac{2(n-1)}{R}$ and $\frac{1}{f'} = \frac{2(n'-1)}{R'}$, we have $f' = f\frac{n-1}{n'-1} \cdot \frac{R'}{R}$ $= f \cos r \frac{n-1}{n'-1}$. It therefore only remains to determine n', the apparent index of refraction. As the problem is one in spherical trigonometry, suppose a sphere described around the centre of the lens and projected in Fig. 2, the eye lying in the axis of the lens prolonged. Let $CA = i$, the angle through which the lens has been turned, and $CE = r$, the corresponding angle of refraction. Then if the surface of the glass is vertical, as at the centre of the lens, the incident ray will be AC and the refracted ray CE. Next suppose the surface slightly inclined by the amount $CD = BC = v$, as is the case for the upper and lower parts of the lens. $AB = i'$ will now be the angle of incidence; and, to construct the refracted ray, we have first the condition that $\sin i' = n \sin r'$, and secondly that the incident and refracted ray shall lie in the same plane with the normal BCD. To construct it, pass a plane through the normal BC and the incident ray AC, which will intersect the sphere along the great circle AB and FD; on this, lay off $DE' = r'$ such that $n \sin r' = \sin i'$, but, as v is infinitesimal, i' will be sensibly equal to i, and r' to r. Now in the right-angled spherical triangle FCD, $\sin CD = \sin DF \sin CFD$, or $\sin v = v = \sin i \times F$, or $F = \frac{v}{\sin i}$; and in the triangle FEE', $\sin EE' = \sin FE' \sin EFE'$, or $EE' = \sin (i - r)\, F$, or, substituting the value of F just found, $EE' = v\,\frac{\sin(i-r)}{\sin i}$. Calling i'' and r'' the angles of incidence and refraction of the ray with regard to the section of the lens made by the plane of refraction, then i'' will not equal BC, but will be the angle which, when projected on the plane of the section of the lens, will be BC or $i'' \cos r = BC \therefore i'' = \frac{v}{\cos r}$. Again EE' is the angle

Fig. 2.



through which the ray is bent, or $i'' - r'' = v \frac{\sin(i-r)}{\sin i}$, or subtracting, $r'' = v\left[\frac{1}{\cos r} - \frac{\sin(i-r)}{\sin i}\right] = v \frac{\sin i - \sin(i-r)\cos r}{\sin i \cos r}$; but $n' = \frac{i''}{r''}$, which, with the above values, gives $n' = \frac{\sin i}{\sin i - \cos r \sin(i-r)}$. Substituting this value in the equation $f' = f \cos r \frac{(n-1)}{(n'-1)}$ gives $f' = f$ $(n'-1) \frac{\sin i - \sin(i-r)\cos r}{\sin(i-r)}$. This would be the focal distance if the rays on emerging remained in the plane of the section of the lens. But they pass into a plane inclined to this $i-r$, hence the observed focus f'' will be such that when projected on the plane of the section it will equal f', or $f'' \cos(i-r) = f'$. Hence finally $f'' = f$ $(n-1) \frac{\sin i - \sin(i-r)\cos r}{\sin(i-r)\cos(i-r)}$. This last step may be open to criticism, but the close agreement with observation seems to justify it.

In Table IV., this formula is compared with observation, as the law for the vertical slit is compared in Table III. The columns in the two tables correspond, and it will be noticed that the agreement is very close.

TABLE IV.

i.	1.5.	$\frac{df}{dn}$	1.55.	Obs.	e.
0°	100.0	0 0	100.0	100.0	0.0
5°	99.9	0.0	99.9	100.2	+0.3
10°	99.2	0.2	99.3	99.5	+0.2
15°	97.7	0.3	97.8	98.5	+0.7
20°	96.1	0.5	96.3	96.4	+0.1
25°	93.7	0.6	94.2	94.3	+0.1
30°	91.1	0.8	91.5	92.0	+0.5
35°	88.3	1.0	88.8	89.0	+0.2
40°	84.7	1.2	85.3	85.7	+0.4
45°	81.1	1.5	81.8	82.0	+0.2
50°	77.2	1.7	78.0	77.8	—0.2
55°	73.2	1.9	74.1	73 9	—0.2
60°	69.0	2.1	70.0	69.8	—0.2
65°	64.7	2.4	65.9	65.5	—0.4
70°	60.4	2.6	61.7	62.0	+0.3
75°	56.3	2.8	57.7	58.1	+0.4
80°	52.1	3.0	53.6	54.1	+0.5
85°	48.3	3.2	49.9	50.4	+0 5
90°	44.8	3.4	46.5		

The principal practical application of these results is to photographic lenses. It will be seen that a single lens, even if perfectly corrected for spherical and chromatic aberration, is still subject to this defect. Con-

structing the curves with polar co-ordinates, taking the radius vector equal to the focal length and its angle equal to the angle of incidence, we obtain a line every point of which would be in focus at the same time. This shows that in a photographic camera for lines passing through the axis, corresponding to the vertical slit, the surface instead of being a plane should have a radius of curvature of only .3 the focus. For lines perpendicular to these, or circles concentric with the centre, corresponding to the horizontal slit, the curvature should be .7 the focus. We also see the importance of having telescope lenses carefully centred, and why the images of stars, if this adjustment is not exact, are elliptical instead of circular.

Since writing the above, a further application of these formulas has been suggested in the case of the eye, that the imperfect vision at a distance from the centre of vision may be due to the rays passing obliquely through the lens. It will also be noticed that the curvature of the retina corresponds nearly with that which would give the best vision. As stated above, for radial lines the radius of curvature should be about .3, and for concentric circles .7, its distance from the lens. The actual curvature in the normal eye is about .5, or the mean of these values.

VIII.

BRIEF CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF HARVARD COLLEGE.

No. I.

ON THE EFFECT OF HEAT UPON THE MAGNETIC SUSCEPTIBILITY OF SOFT IRON.

By H. Amory and F. Minot.

Presented, Jan. 12, 1875.

The determination of the question whether heat influences the capabilities of soft iron to be magnetized appears to us to be an interesting question, since, in the later forms of magneto-electric engines, the armatures necessarily become heated by their movement in a magnetic field. The question is also of interest from a molecular point of view. We have confined ourselves to the determination of the effect of such heating upon the induced currents produced by suddenly passing an electric current about the bar of soft iron, which is heated to different temperatures.

Great difficulty was anticipated at first in determining the temperatures of the bar at different times. Preliminary experiments show, however, that the question resolved itself into observing the decided changes at the temperature of dull red heat and at white heat. The first method of experimenting was as follows: bars of soft iron, 1 cm. in diameter, were placed so as to form the armatures of the electro-magnets; a coil of fine wire, the induction coil, was slipped upon these bars, forming the armatures, and the curve was drawn, which showed the distribution of magnetism over the armature when the electro-magnets were excited; then the bar was heated, and the change in the curve noted. The induction coil was so placed that its plane was at right angles to that of the coils of the exciting electro-magnets. This apparatus showed a slight increase of magnetic susceptibility in the bars of soft iron as they were heated. The magnetic state increased up to the point when the bar began to change slightly in color from the effect of the heat; it then remained constant. Owing to the diffi-

culty of heating bars of comparatively large diameter to a point beyond that of dull red heat, this method was abandoned, and the following was adopted. The testing apparatus consisted of an electro-magnet, horseshoe in form, but the wire of which was placed at the bend of the horseshoe, so that the electro-magnet was practically a straight one, with a horseshoe-shaped core. Upon one of the limbs of the horseshoe the induction coil was slipped, so as to still remain at right angles with the electro-magnet. The soft iron bar or wire was then made the armature of the electro-magnet. It was found that this arrangement was a very sensitive one; for any change in the condition of the wire forming the armature was immediately shown when the electro-magnet was excited, and an induced current passed through the fine induction coil. This method allowed us to experiment with wires, or bars of any suitable diameter. For, as it will be shown later, the size of the armature had very little effect upon the strength of the induced currents produced at making and breaking the current in the electro-magnet. We shall speak of the horseshoe-shaped core and the armature as a magnetic circuit, which of course is a mere convenient term. When the armature is applied to the poles of the horseshoe, and the electro-magnet is excited, then such a circuit may be said to be closed. The bars or wires were tested at a dull red heat, and also at white heat. The first bar used was 2 mm. in diameter, and the following table shows the results obtained. Six observations were taken, at intervals of one minute apart.

TABLE I.

Time.	Deflection of Galv. Needle before heating.	Deflection of Galv. Needle on rise of temperature.	
Min.		Dull Red.	White Heat.
1	58	59	52
2	57	58	58
3	57	59	52
4	56	59	52
5	56	59	52
6	56	58	52

When the magnetic circuit was closed by the armature, the first induced current which was produced by making the circuit of the electro-magnet was greater than the succeeding ones. This was doubtless due to residual magnetism. We do not speak of the induced current which resulted from breaking the circuit of the electro-magnet; for this was equal to that produced by making the circuit. The mean of the two renderings gave the correct result.

The following show the results obtained by varying the size of the bars or wires forming the armatures: —

TABLE II. — DIAMETER OF BAR, 2.5 MM.

Time.	Deflection of Galv. Needle before heating.	Deflection of Galv. Needle on rise of temperature.	
Min.		Dull Red.	White Heat.
1	59	60	52
2	58	59	53
3	57	60	50
4	57	58	52
5	57	59	52
6	56	60	52

TABLE III. — DIAMETER OF BAR, 3 MM.

Time.	Deflection of Galv. Needle before heating.	Deflection of Galv. Needle on rise of temperature.	
Min.		Dull Red.	White Heat.
1	58	61	52
2	56	59	50
3	57	60	51
4	56	59	53
5	57	59	52
6	56	60	50

Bars of various small diameters were used with results corresponding to those given in the above tables. It was evident that the size of the armature had very little effect upon the induced magnetism, or upon our testing induced currents. To determine this point, we made a series of determinations of the strength of the induced currents which resulted from the employment of armatures of various sizes. The results are contained in the following table: —

Weight of Armature in grammes.	Deflection of Galvanometer Needle.
470	150
340	151
200	148
100	150

This fact has an important bearing upon the practical construction of magneto-electric engines; for it seems that we can vary the size of magnetic revolving armatures, within large limits, to suit considerations of speed, &c., without affecting materially the induced currents, through

coils upon the limbs of horseshoe magnets, near the poles of which the armature revolves. The above tables show that there is a slight increase of magnetism as the bar heats. Preliminary tests showed that the increase was slow, but gradual, up to the temperature of dull red heat; then, as the bar was heated to the temperature of white heat, its magnetic susceptibility fell, and apparently became less as the temperature increased beyond that of white heat. On cooling, the bar quickly regained its normal magnetic state of susceptibility. Thus, the curve which represents such a change would rise nearly as a straight line, inclined to the axis of X at a slight angle, up to the point of dull red heat; then it would fall quickly, in nearly a straight line, to the point of white heat; rising quickly again to the point of dull red heat, forming a V-shaped inflection in the curve, and then falling again, in nearly a straight line, towards the axis of X. One of Thomson's reflecting galvanometers was used in the above experiments. The results of the above show that the heating of the armatures of a magneto-electric engine increases rather than diminishes its magnetic susceptibility.

IX.

A CONSPECTUS OF THE NORTH AMERICAN HYDROPHYLLACEÆ.

By Asa Gray.

Presented, March 9, 1875.

Tribus I. HYDROPHYLLEÆ. Ovarium uniloculare: placentæ dilatatæ primum succulentæ loculum fere implentes, demum membranaceæ capsulam totam intus vestientes et liberæ, facie interiore seminiferæ. Corolla æstivatione sæpius convolutiva. Stylus bifidus. Seminis albumen corneum.

* Genitalia exserta. Perennes, nunc biennes, foliis alternis.

1. Hydrophyllum Tourn.

* * Stamina corolla breviora: calyx post anthesin accrescens. Annuæ, foliis aut infimis aut omnibus oppositis.

2. Nemophila Nutt. Calycis sinus dentibus reflexis appendiculati. Corolla calyce longior. Semina sæpius quasi carunculata.
3. Ellisia Linn. Calyx exappendiculatus, corollam superans vel subæquans Semina nuda, pauca (quandoque 1–2 inter placentam et valvam abscondita!).

Tribus II. PHACELIEÆ Benth. Ovarium 1–2-loculare. Capsula loculicida: valvæ medio (aut stricte aut mediante semiseptorum) placentiferæ. Placentæ angustæ. Stylus bifidus, rarissime indivisus. Corolla æstivatione imbricata.

* Folia omnia opposita, integerrima: cymæ scorpioideæ: stylus apice bifidus: placentæ breves, 2-spermæ, tenues, a semiseptis plerumque secedentes!

4. Draperia.

* * Folia præter infima alterna: stylus pl. m. bifidus. Caulescentes.

+ Sepala vel calycis segmenta conformia.

5. Phacelia. Corolla decidua (*P. sericea* excepta), nec flava. Stamina æqualiter basi corollæ inserta. Cymæ vel quasi-racemi spicæve plus minus scorpioideæ.
6. Emmenanthe. Corolla (flava vel ochroleuca, campanulata) subscarioso- vel marcescenti-persistens. Cæt. *Phaceliæ*.
7. Conanthus. Stamina inæqualia tubo corollæ longe infundibuliformis inæqualiter inserta. Flores terminales et alares, sessiles.

+ + Sepala dimorpha; 3 exteriora maxima, cordata, reticulata; 2 interiora parva linearia. Cæt. *Phaceliæ*.

8. Tricardia.

* * * Folia alterna, reniformi-rotundata, palmatiloba: stylus indivisus: ovarium glabrum. Inflorescentia racemiformis subscaposa.

9. Romanzoffia.

* * * * Folia (alterna, integerrima) omnia radicalia, scapos unifloros fulcrantia: stylus apice bifidus.

10. Hesperochiron.

Tribus III. NAMEÆ Benth. Ovarium pl. m. biloculare. Capsula loculicida: placentæ divisæ per semisepta valvis integris raro bisectis adnatæ. Styli 2. Corolla æstivatione imbricata. — A præcedente stylis discretis corolla plicis semper destituta ægre distincta.

11. Nama. Corolla infundibuliformis vel fere hyprocraterimorpha. Genitalia inclusa. Capsula membranacea, valvis integris, semiseptis placentas pluri-polyspermas auferentibus. Herbæ vel suffruticuli, foliis integerrimis.

12. Eriodictyon. Corolla infundibuliformis vel subcampanulata. Genitalia subinclusa. Capsula crustacea, loculicide dein septicide in semi-valvas seu cocca 4 uno latere aperta oligosperma fissa. — Frutices vel suffrutices, foliis rigidis dentatis.

Tribus IV. HYDROLEÆ Benth. Ovarium biloculare: placentæ magnæ fungosæ, multiovulatæ. Capsula marginicide septifraga, pl. m. bivalvis, nunc irregulariter rupta; valvis nudis placentis crassis prorsus in unicam septo tenui bimarginatam connatis axi relinquentibus. Corolla fere rotata, æstivatione imbricata. Styli 2. Seminis albumen carnosum.

13. Hydrolea.

1. HYDROPHYLLUM Tourn.

§ 1. EUHYDROPHYLLUM. Rhizomatibus horizontalibus perennans: calyx immutatus, sinubus (no. 5 subexcepta) nudis.

* Folia pinnatifida vel pinnatisecta: calyx hispidus.

+ Pedunculus petiolo sæpissime glomerulo brevior: antheræ brevi-oblongæ.

1. H. capitatum Dougl. — Var. alpinum Watson, Bot. King, p. 249. Cæspitoso-subacaule; cymis magis evolutis quasi radicalibus.

+ + Pedunculus petiolo sæpius folio longior: antheræ oblongo-lineares.

++ Folia caulina circumscriptione elongato-oblonga, 7–15-partita: cymæ densæ.

2. H. macrophyllum Nutt. Hispidum, validum; calyce albo-hispido profunde 5-fido, lobis e basi lata subulatis; corolla albida semipollicari. — Atlantic United States, chiefly west of the Alleghany Mountains.

3. H. OCCIDENTALE. Pubescens, nunc parce hispidum, 1–2-pedale; segmentis foliorum oblongis incisis vel paucilobatis obtusis; pedunculis gracilioribus; calyce 5-partito, lobis lanceolatis obtusiusculis; corolla ⅓-pollicari. — *H. capitatum* Hook. & Arn. Bot. Beech. p. 371; Torr. Bot. Whipp. p. 69, non Dougl. — Pacific States.

Var. WATSONI. Humile, pube molliore nunc cinerea; calyce parce hispido; cyma minus densa. — *H. macrophyllum* var. *occidentale* Wats. l. c. pro parte. — Utah, California.

Var. FENDLERI. Pube magis hirsuta vel hispida nec cinerea; segmentis foliorum ovato-lanceolatis acutis vel acuminatis inciso-serratis; pedunculo breviore; cyma laxiuscula. — Colorado, New Mexico.

++ ++ Folia caulina circumscriptione ovata, 3–5-partita vel secta.

4. H. VIRGINICUM Linn. — Atlantic United States to Alaska.

* * Folia palmati- (5–7-) lobata: calycis sinus dentibus inconspicuis erectis quandoque appendiculati.

5. H. CANADENSE Linn. — Atlantic United States and Canada.

§ 2. DECEMIUM Raf. Bienne: calycis post anthesin modice accrescentis sinus dentibus reflexis appendiculati: stamina ultra corollam rotato-campanulatam minus exserta.

6. H. APPENDICULATUM Michx.

2. NEMOPHILA Nutt.

* Ovula 8–24: semina 5–15: folia pleraque opposita, pedunculo elongato superata. Californicæ.

+ Semina subglobosa, lævia, caruncula papilliformi: corolla alba violaceo maculata.

1. N. MACULATA Benth.

+ + Semina oblongo-ovalia, demum corrugata vel tuberculato-rugosa, caruncula decidua.

2. N. INSIGNIS Dougl. Foliis 7–9-partitis: corollæ læte cæruleæ plicis internis brevibus rotundatis apice liberis breviter hirsutis.

3. N. MENZIESII Hook. & Arn. Minor; foliis 3–9-fidis; corollæ dilute cæruleæ seu albæ fundo sæpius punctatæ vel maculatæ plicis angustis adnatis hirsuto-ciliatis. — *N. Menziesii* Hook. & Arn. Bot. Beech. p. 152 & 372, forma *α*. *N. liniflora* Fisch. & Meyer, Sert. Petrop. t. 8, forma majora flore cæruleo. *N. pedunculata* Benth.

Hydroph., forma parviflora. *N. atomaria* Fisch. & Meyer; Bot. Reg. t. 1940: forma corolla pallida brunneo-punctata. *N. discoidalis* Hortul.; Fl. Serres, 2, t. 75, forma corolla aut fundo aut fere tota brunneo-purpurea.

* * Ovula 4, i. e. placentæ biovulatæ.

+ Alternifoliæ, plerumque grandifloræ: plicæ corollæ ad basim filamentorum latissimæ: semina globosa fere ecarunculata.

4. N. PHACELIOIDES Nutt. Semina vix punctata. — Arkansas and Texas.

5. N. AURITA Lindl. Semina reticulata subfavosa. Caules setis retrorsis aculeolato-hispidi. Folia basi vel petiolo alato auriculato-amplexicaulia. — California.

6. N. RACEMOSA Nutt. in herb. Præcedenti affinis, minor, debilis; foliis brevioribus circumscriptione ovatis vel oblongis 5–7-fidis, petiolo nudo; floribus plerisque racemosis parvulis; corolla calyce paullo longiore lin. 4–5 diametro. — California; San Diego, Nuttall. Island of Catalina, Dall and Baker.

+ + Parvifloræ, tenellæ: corolla campanulata calyce longior, plicis exiguis vel evanidis: folia inferiora opposita, superiora sæpius alterna, pedunculo longiora.

7. N. PARVIFLORA Dougl. *N. heterophylla* Fisch. & Meyer, l. c. — California to British Columbia.

8. N. MICROCALYX Fisch. & Meyer, l. c. *N. evanescens* Darby, S. Bot. *N. parviflora* A. DC., quoad pl. Louisianæ. *Ellisia microcalyx* & *E. ranunculacea* Nutt. — Virginia to Texas.

+ + + Brevifloræ, alternifoliæ, corollæ plicis manifestis.

9. N. BREVIFLORA. Spithamæa, diffusa, debilis; foliis fere omnibus alternis pinnatipartitis, segmentis 3–5 approximatis oblongo-lanceolatis acutis integerrimis; pedunculis petiolum vix æquantibus; calycis hirsuto-ciliati appendicibus segmentis dimidio brevioribus; corolla late campanulata calyce breviore, plicis cuneatis apice lato libero fimbriato-inciso; stylo apice tantum bifido; semine unico globoso. — *N. parviflora* Wats. Bot. King, p. 249, excl. char., non Dougl. — Mountains of Utah, S. Watson. A young plant of the same is in Tolmie's Snake Country collection from the same district.

3. ELLISIA Linn.

§ 1. EUELLISIA. Ovula tribus, i. e. omnia ventralia, gemina: semina globosa, testa alveolato-reticulata: folia pinnatipartita.

1. E. NYCTELEA L. *E. ambigua* Nutt., forma tenella. — Eastern N. America.

2. E. MEMBRANACEA Benth. — California. Corolla with one lobe external in æstivation. Ovary not wholly "glabrous." The apex bears a few very stout bristles.

§ 2. EUCRYPTA. Placentæ utrinque ovuliferæ, heterospermæ, nempe facie ventrali biovulata, dorsali 1–2-ovulata monosperma: semina ovalia; normalia rugoso-tuberculata, teretia; posticum meniscoideum læve inter valvam et placentam persistentem absconditum! Folia 2–3-pinnatipartita: flores quasi-racemosi. — *Eucrypta* Nutt. Pl. Gamb. p. 159.

3. E. CHRYSANTHEMIFOLIA Benth. *Eucrypta paniculata* & *E. foliosa* Nutt. l. c. *Phacelia micrantha?* var. *pinnatifida* Torr. in Ives, Colorad. Exp. Bot. p. 21. — California.

4. DRAPERIA Torr.

1. D. SYSTYLA Torr. in Gray Proc. Am. Acad. 7, p. 401. *Nama systyla* Gray, l. c. 6, p. 37. — I have nothing of importance to add to what is known of this interesting Californian plant, except that the dehiscence is somewhat peculiar. The thin dissepiment is complete; the semisepta meeting in the centre, but without any placental enlargement; the ovules, two in each cell, are pendulous from near its summit: in dehiscence a thin central portion, or placenta, usually separates neatly from the semisepta and remains between the four seeds, falling with them, so that when the capsule is closed again a central foramen is left.

5. PHACELIA Juss.

This comprehensive genus is certainly polymorphous, but no more so than *Eutoca* R. Br. would be, if the two genera were retained as proposed by Brown. Most of the true quadriovulate Phacelias are nearly represented by species of *Eutoca*, — as *P. circinata*, *Breweri*, *humilis*, and *brachyantha* by *P.* (*Eutoca*) *circinatiformis*, *divaricata*, and *curvipes*, and *P. malvæfolia* by *P.* (*Eutoca*) *Bolanderi* and *loasæfolia;* while the set of which *P. tanacetifolia* and *congesta* are the type is imitated in foliage and inflorescence by *P. infundibuliformis;* and *P. bipinnatifida* and the section *Cosmanthus* are related to *P.* (*Cosmanthoides*) *parviflora*, *glabra*, *patuliflora*, &c. Indeed Brown's *Eutoca parviflora* and the closely allied species, generally with 3–4-ovulate placentæ, occasionally show a reduction to a single pair. It is still less practicable to keep

up *Cosmanthus* and *Microgenetes* as genera. That the internal plicæ or appendages of the corolla are not available for generic distinctions was early seen by Bentham. If absent in the Chilian *Microgenetes*, they are conspicuous in nearly related North American species, the group being well marked by the transversely corrugated seeds. I have arranged the about fifty species known to me under seven subgenera, characterized by the ovules, seeds, and in part by the presence or absence of the corolline plicæ.

§ 1. EUPHACELIA. Placentæ 2-ovulatæ: semina verticalia, testa areolata vel alveolata: corollæ lobi haud fimbriati, tubo plicis lamelliformibus per paria juxta basim staminum.

* Folia inferiora ramique opposita: spicæ laxæ, parum secundæ vel circinatæ: pubes nunquam hispida.

1. P. NAMATOIDES. Annua, subspithamæa, tenuis, inferne glaberrima, superne glanduloso-pubescens; ramis brachiatis; foliis lineari-lanceolatis integerrimis subpetiolatis spicas cymasve primum superantibus; sepalis spathulato-linearibus corolla anguste campanulata brevioribus capsulam globosam minime hirsutam superantibus; staminibus styloque demum bipartito inclusis; plicis basi staminum subadnatis brevibus; seminibus alveolato-reticulatis. — *Nama racemosa* Kellogg in Proc. Acad. Calif. 5, p. 51. — In the higher Sierra Nevada, California, Bolander, Kellogg. It is not surprising that this anomalous little plant was described as a *Nama*. Its aspect is very unlike any other *Euphacelia*, but is somewhat like *Emmenanthe glaberrima*. The geminate ovules and seeds are those of *Euphacelia*.

* * Folia (generis) alterna: flores scorpioideo-spicati: pubes pl. m. hispida vel hirsuta: plicæ corollæ latæ, sæpissime basi staminum utrinque adnatæ.

+ Folia aut integerrima aut pinnati-3–5-partita segmentis integerrimis: capsula ovata, acuta.

++ Perennes vel biennes: genitalia longe exserta.

2. P. CIRCINATA Jacq. f.; A. DC., cum syn. *P. leucophylla* Torr. in Frem. Rep. 1, p. 93. *P. canescens* Nutt. Pl. Gamb. — Var. CALYCOSA: forma calycis lobis demum ampliatis oblongis vel obovato-spathulatis.

++ ++ Annuæ, minores.

3. P. BREWERI. Formæ depauperatæ præcedentis similis, gracilior; radice exili; corolla violacea lato-campanulata calycis lobis linearibus duplo longiore filamenta glabra parum superante. — On Monte

Diablo, California, Brewer. A span high. Corolla barely 3 lines long.

(3ª.) P. BRACHYANTHA Benth. Chilensis, foliis latioribus subintegris, pube molliori, calyce longiore, corolla angusto-campanulata, staminibus longe inclusis a præcedente diversa.

4. P. HUMILIS Torr. & Gray, Pac. R. R. Exp. 2, p. 22, t. 7. Pubescens; foliis spathulato-oblongis vel oblanceolatis obtusis raro 1–3-lobatis, venis ramosis; spicis solitariis vel paniculatis laxiusculis; corolla cærulea campanulata calycis lobis sæpius linearibus longiore; filamentis breviter exsertis. — Var. CALYCOSA: forma calyce accrescente, lobis spathulatis.

+ + Folia rotundato-cordata, petiolata, palmatiloba vel incisa, lobis serratis: herba setis urentibus hispida: genitalia longe exserta.

5. P. MALVÆFOLIA Cham. in Linnæa, 4, p. 494.

+ + + Folia circumscriptione oblonga vel angustiora, pinnato-dentata ad pinnatisecta segmentis dentatis incisisve: capsula globosa vel ovoidea, obtusa: semina facie ventrali excavata medio carinato: spicæ scorpioideæ sæpius cymoso-congestæ.

++ Calyces haud setoso-hispidi, capsulam parum superantes: seminum testa reticulata.

= Folia haud pinnatisecta, plerumque inciso-crenata: genitalia longe exserta: biennes?

6. P. INTEGRIFOLIA Torr. Ann. Lyc. N. Y. 2, p. 222, t. 3. Spithamæa ad bipedalem, stricta, viscido-pubescens; foliis crebris ovato-oblongis seu lanceolatis sessilibus vel inferioribus brevi-petiolatis basi subcordatis crenato-dentatis nunc incisis; inflorescentia primum thyrsoidea; corolla angusto-campanulata (albida vel subcærulea); stylo semibifido; capsula brevi-ovoidea. — Var. PALMERI: forma hirsutior, thyrso primum virgato; foliis nunc acute dentatis. — *P. Palmeri* Torr. in Wats. Bot. King, p. 251.

7. P. CRENULATA Torr. in Wats. Bot. King, l. c. Spithamæa ad pedalem, a basi sæpe ramosa, viscido-pubescens vel hirsuta; foliis plerisque petiolatis spathulato-oblongis crenato-dentatis vel pinnatifidis raro lyratis, lobis crenulatis; spicis mox evolutis patentibus; corolla rotato-campanulata læte violacea, plicis internis latissimis; stylo ultra medium partito; capsula globosa.

= = Folia 1–2-pinnatisecta vel partita, segmentis pinnatifidis vel incisis: genitalia pl. m. exserta: annuæ.

8. P. GLANDULOSA Nutt. Pl. Gamb. Viscido-pubescens, glandulosa, vix hirsuta; foliis bipinnatipartitis, lobis crebris parvis; calycis lobis oblongis spathulatisve; reti seminum lævi. — *P. Popei* Torr. & Gray, Pac. R. R. Exp. 2, p. 122, t. 10: forma minus pubescens, corollæ lobis integerrimis. "*Eutoca glandulosa* Nutt.," Hook. Kew Jour. 3, p. 293.

Var. NEO-MEXICANA: corollæ lobis aut tenuiter aut insigniter eroso-denticulatis. — *P. Neo-Mexicana,* Thurber in Bot. Mex. Bound. p. 143.

9. P. CONGESTA Hook. Pubescens, sæpius cinerea, fere eglandulosa; foliis 3–7-sectis partitisve, segmentis paucis parvis inter majora oblonga seu ovalia inciso-lobata positis, infimis petiolatis, summis confluentibus; calycis lobis fere linearibus; stylo semibifido; seminibus reticulato-scabris. — *P. tanacetifolia* A. DC., quoad pl. Tex. Berland. — This species inhabits Texas; the following, California.

++ ++ Calyces setoso-hispidi vel ciliati, capsulam longius superantes, lobis sæpe inæqualibus: stylus bipartitus: seminum testa alveolata, reti incrassato demum subrugosa.

= Genitalia exserta: folia pleraque 1–2-pinnatisecta.

10. P. TANACETIFOLIA Benth. Erecta, hispida vel hirsuta, haud vel superne parum glandulosa; foliis 9–17-sectis, segmentis 1–2-pinnatipartitis sessilibus, lobis sæpius lineari-oblongis; spicis elongandis; calycis lobis linearibus seu lineari-spathulatis capsula ellipsoidea vix duplo longioribus; genitalibus maxime exsertis. — California, chiefly towards the coast.

11. P. RAMOSISSIMA Dougl. Divergenti-ramosa, superne glandulosa et viscida; foliis 5–9-sectis vel partitis. segmentis sæpius oblongis pinnatifido-incisis; spicis glomeratis vix elongandis, pedicellis demum horizontalibus; genitalibus modice exsertis; calycis lobis linearibus spathulatisve capsula globosa vel subovata 3–4-plo longioribus. — California, and through the dry interior region from Arizona to Washington Territory. Passing apparently into the preceding and the following.

Var. HISPIDA. Setis longis albis barbata, saltem in calycis lobis elongatis (fructif. lin. 4–6 longis); spicis fructiferis apertis racemiformibus; foliis minus sectis. — Santa Barbara to San Diego, California.

= = Genitalia corolla rotato-campanulata haud longiora: spicæ laxiusculæ.

11. P. CILIATA Benth. This resembles depauperate forms of the two preceding; but the spikes are simple or merely geminate, and at

length loosely flowered, and the stamens do not surpass the corolla. As to the calyx-lobes, although ovate-oblong at maturity in the original specimens of Douglas, they are sometimes much narrower, even linear-lanceolate. They are about equally accrescent in all these species, and also variable. The seeds have broader pits and less thickened separating walls than the preceding species. More specimens are much wanted.

* * * Folia alterna, membranacea: flores laxe racemosi: corollæ rotato-campanulatæ plicæ elongatæ villoso-ciliatæ per paria approximatæ a staminibus remotæ: testa seminum subcarnosa parum areolata: biennes, glanduloso-viscidæ, Alleghanienses.

13. P. BIPINNATIFIDA Michx., & var. BREVISTYLIS Gray, Man. *P. brevistylis* Buckley.

§ 2. COSMANTHUS. Corolla subrotata, lobis fimbriatis, plicis nullis. Cætera *Euphaceliæ* subdiv. ultimæ. Herbæ annuæ, parvulæ, Am. Bor. Orientalis. — *Cosmanthus* Nolte. *Cosmanthus* § *Eucosmanthus* A. DC. pro parte.

14. P. PURSHII Buckley; Gray, Man. ed. 1, p. 342. *P. fimbriata* Auct.

15. P. FIMBRIATA Michx.; Gray, Man. ed. 2, p. 328. Perhaps only a smaller and mountain form of the other.

Var.? BOYKINI. Suberecta, ramosa; racemis plurifloris demum strictis, pedicellis fructiferis erectis calyce haud longioribus; corollæ lobis multo minus fimbriatis. — Upper part of Georgia, Boykin. Probably a state of *P. fimbriata* inhabiting a lower and drier region, perhaps a distinct species.

§ 3. COSMANTHOIDES. Placentæ 3–8-ovulatæ, rarissime 2-ovulatæ: semina verticalia, testa reticulata: corolla rotato-campanulata, plicis nullis vel inconspicuis (perangustis) per paria approximatis a staminibus remotis: capsula subglobosa obtusissima. Herbæ humiles vel tenellæ Am. Bor. Or. et Mex., hirsuto-pubescentes, foliis pinnatifidis, floribus racemosis.

* Herbæ annuæ, tenues, parce hirsutulæ vel glabellæ, foliis caulinis pinnatifidis sessilibus: ovula in placentis nunc 3–4, nunc 2!

16. P. GLABRA Nutt. Fl. Arkans. in Trans. Am. Phil. Soc. 5, p. 192. A subsequente peraffini glabritie, exiguitate, calycis lobis ovalibus oblongisve capsulam vix superantibus nimis differt.

17. P. PARVIFLORA Pursh; Gray, Man. ed. 5, p. 369. *Polemonium dubium* Linn. *Eutoca parviflora* R. Br. *Cosmanthus parviflorus* A. DC. *Phacelia pusilla* Buckley, ex char.

Var. HIRSUTA. Forma vegetior, hirsutior. — *P. hirsuta* Nutt. in Trans. Am. Phil. Soc. l. c.

* * Herba Mexicana diffusa, "radice perenni," foliis plerisque pinnatisectis, omnibus petiolatis.

(17*.) P. PIMPINELLOIDES. — *Eutoca pimpinelloides* & *brevifolia* Spreng. Syst. 1, p. 569. *E. Mexicana*, Benth. Hydrophyll. l. c. *E. Andrieuxii* & *Cosmanthus Mexicanus* A. DC. l. c. (Coll. Mex. Bourgeau, no. 493.)

* * * Herbæ Texanæ, annuæ, foliis caulinis incisis vix pinnatifidis, floribus majoribus (6–12 lin. latis): placentæ 7–9-ovulatæ.

18. P. PATULIFLORA. — *Eutoca patuliflora* Engelm. & Gray, Pl. Lindh. 1, p. 45.

19. P. STRICTIFLORA. — *Eutoca strictiflora* Engelm. & Gray, l. c. The seeds of this species, besides the minute reticulation or pitting, are coarsely and obscurely rugose at maturity, in this respect approaching the *Microgenetes* section.

§ 4. GYMNOBYTHUS. Placentæ dilatatæ multiovulatæ: semina parum descendentia, testa foveolata: corolla rotato-campanulata, intus cum filamentis subæquilongis prorsus inappendiculata: stylus bipartitus: capsula ovata, apice cuspidato-acuminata. Herbæ annuæ, Californicæ, glanduloso-viscidissimæ, foliis ovatis dentatis, racemis solitariis vel geminis laxifloris. — *Cosmanthus* § *Gymnobythus* A. DC.

20. P. VISCIDA Torr. Bot. Mex. Bound. p. 143. — *Eutoca viscida* Benth. *Cosmanthus viscidus* A. DC. — Var. ALBIFLORA. *Eutoca albiflora* Nutt. Pl. Gamb. p. 158.

21. P. GRANDIFLORA. — *Eutoca grandiflora* Benth. l. c. *E. speciosa* Nutt. l. c. *Cosmanthus grandiflorus* A. DC.

§ 5. WHITLAVIA. Placentæ multiovulatæ, raro pauciovulatæ: semina præcedentium: corolla plicis destituta: sed filamenta (capillaria exserta) ima basi intus squamula parva truncata vel emarginata adnata appendiculata! Herbæ annuæ, Californicæ, facie præcedentium, at minus glandulosæ, pedicellis petiolisque longioribus, stylo parum semibifido.

* Corolla cylindraceo-campanulata, speciosa: ovula numerosissima placentæque *Gymnobythi*. — *Whitlavia* Harvey.

22. P. WHITLAVIA. — *Whitlavia grandiflora* & *W. minor* Harvey in Lond. Jour. Bot. 5, p. 312, t. 11.

* * Corolla aperte brevi-campanulata, alte 5-fida: placentæ angustæ.

23. P. PARRYI Torr. Bot. Mex. Bound. p. 144. Placentæ 20–30-ovulatæ, 15–20-sperma. Corolla speciosa, filamenta subæquans.

24. P. LONGIPES Torr. in herb. Gracilis, diffusa, glandulosa, parum hispida; foliis caulinis ovalibus vel subcordatis grosse obtuseque 5–8-dentatis (semipollicaribus) petiolo filiformi brevioribus; racemo perlaxo, pedicellis filiformibus; staminibus styloque (ad medium fisso) corolla vix semipollicari (alba?) sat longioribus; placentis 8–10-ovulatis. — Santa Barbara Co., California, Torrey.

§ 6. EUTOCA. Placentæ 6–multiovulatæ: semina pendula vel descendentia, testa reticulata vel foveolata, nec rugosa: corollæ plicæ 10 verticales, lamelliformes: capsula ovata seu oblonga. Herbæ plerumque occidentales, paucæ boreales. — *Eutoca* R. Br. excl. sp. *Eutoca* § *Ortheutoca* A. DC.

* Perennes (*P. loasæfolia* et *Bolanderi?* excepta), Californicæ: genitalia exserta: corolla brevi-campanulata, plicis latissimis obliquis basi filamentis adnatis: flores cymoso-congesti: folia ovata, petiolata, inciso-pinnatifida.

+ Placentæ dilatatæ 40–50-ovulatæ: genitalia minus exserta.

25. P. BOLANDERI. Setis gracilibus hispida, superne viscido-pubescens; caule valido e radice ut videtur perenni erecto bipedali ramoso; foliis radicalibus caulinisque infimis lyratis, segmentis lateralibus 1–2-jugis parvis incisis, terminali foliisque superioribus ovatis ovalibusve inciso-lobatis, basi truncata vel subcordata; cymis 1–3-chotomis mox apertis; corolla subrotata alba (fere pollicem diametro), plicis semiobovatis basi inter se connatis; filamentis parce barbatis styloque semibifido corollam paullo superantibus; antheris oblongis; capsula late ovata acuta polysperma. — Cottonaby Creek, twenty miles north of Noyo, Mendocino Co., California. Appendages of corolla connected in front of the base of the filament, forming a shallow sac behind it.

+ + Placentæ angustæ 6–9-ovulatæ: genitalia insigniter exserta.

++ Radix annua: folia (subpinnatifida, summa sessilia) rami calycesque setoso-hispidissimi more *P. malvæfoliæ:* corollæ plicæ semisubcordatæ, basi auriculato-inflexæ, apice parum libero cuspidatæ!

26. P. LOASÆFOLIA Torr. — Still a little known species, collected near Monterey only by Douglas and Dr. Parry.

++ ++ Radix perennis, crassa: pubes mollis: folia etiam suprema petiolata: spicæ in pedunculo cymoso-glomeratæ: corollæ plicæ obtusissimæ.

27. P. HYDROPHYLLOIDES Torr. in Gray, Proc. Am. Acad. 7, p. 400. Spithamæa vel subpedalis, superne vix hispida, glandulosa; foliis subsericeo-pubescentibus ovatis seu rhomboideis (1–2-pollicaribus) obtusis paucilobatis incisisve longe petiolatis, imis nunc lyratis; cyma brevi glomerata; corollæ violaceæ vel albidæ plicis semi-ovalibus; filamentis glabris; antheris brevi-linearibus; stylo fere bipartito; capsula calycem æquante 6–8-sperma. — Not rare in the high Sierra Nevada.

28. P. PROCERA. Suborgyalis, tenuiter pubescens, superne subglandulosa, pilis hispidis etiam calycis nullis; foliis viridibus (2–5-pollicaribus) ovato-lanceolatis ovatisque acutis laciniato-pinnatifidis, lobis 2–4-jugis acutis; spicis fructiferis cymæ elongandis; corolla alba vel pallida, plicis semi-obcordatis; filamentis parce barbatis; antheris oblongis; stylo supra medium bifido; capsula globoso-ovata vix mucronata 10–18-sperma; seminibus immaturis alato-angulatis. — Mountain meadows of the Sierra Nevada, in Nevada and Sierra counties, Bolander, Lemmon, &c.

* * Perennis: genitalia longe exserta: corolla campanulata circa basim capsulæ marcescenti-persistens (!), plicis majusculis oblongis a filamentis liberis: placentæ pluriovulatæ: semina longitudinaliter costata et reticulata: flores thyrsoideo-congesti. Species boreali-alpina.

29. P. SERICEA Gray in Sill. Jour. (1862) 34, p. 254. *Eutoca sericea* Graham, Bot. Mag. t. 3003. — Folia 1–3-pinnatipartita. — Var. LYALLI: forma nana, minus sericea; foliis subviridibus lobis latioribus; floribus thyrsoideo-capitatis. Rocky Mountains, lat. 49, at 6–7000 feet, Lyall. Oregon forms approach it. — The persistence of the corolla is peculiar to this species. It was first noticed by Watson, in Bot. King, p. 252.

* * * Annuæ: genitalia corollæ rotato-campanulatæ adæquantia: plicæ corollæ angustæ a filamentis liberæ: calycis lobi lineares: stylus apice bifidus: capsula ovata, acuminata vel acuta: spicæ densifloræ thyrsoideo-cymosæ vel paniculatæ.

+ Folia 1–2-pinnatisecta: placentæ 20–30-ovulatæ: semina ovalia, lineatim subalveolatæ.

30. P. Franklinii Gray, Man. Bot. ed. 2, p. 329, & 3, p. 370. *Eutoca Franklinii* R. Br.

+ + Folia linearia seu lanceolata integerrima, vel 2–5-fida lobis lineari-lanceolatis: placentæ 6–8-ovulatæ: semina oblonga, grosse foveolata.

31. P. Menziesii Torr. in Wats. Bot. King. *Hydrophyllum lineare* Pursh. *Eutoca Menziesii* R. Br. *E. multiflora* Dougl. *E. heterophylla* Torr. in Stansb. Rep.

* * * * Annuæ: stamina corolla breviora (in *P. divaricata* nunc fere æquilonga): flores spicati vel racemosi.

+ Folia pinnatisecta, segmentis inciso-pinnatifidis: semina ventre excavato medio carinato modo *Phaceliæ congesta*, etc.

32. P. infundibuliformis Torr. Bot. Mex. Bound. p. 144. Foliis inflorescentia, etc., *P. glandulosæ* similis; corolla infundibuliformi (purpurascente vel alba), lobis parum erosis tubo plus dimidio brevioribus, plicis angusto-oblongis a filamentis liberis; placentis sat dilatatis 8–12-ovulatis; stylo apice bifido; capsula oblonga obtusissima membranacea pleiosperma sepalis angusto-spathulatis adæquante. — New Mexico.

+ + Folia tantum pinnatifida, lobis brevibus obtusis.

++ Spicæ elongandæ: corolla parva: placentæ 6-ovulatæ: capsula obtusissima.

33. P. brachyloba. *Eutoca brachyloba* Benth. l. c. — Monterey and Santa Barbara, California.

++ ++ Racemi laxiflori, pedicellis elongatis: corolla late campanulata, calyce duplo longior, plicis elongatis a filamentis parce barbatis fere liberis: plantæ humiles, diffusæ, Californicæ.

34. P. Douglasii Torr. l. c. *Eutoca Douglasii* Benth. l. c. Pilis patulis hirsuto-pubescens. Folia pluripartita vel lobata. Sepala spathulata. Corolla ampla, semipollicaris. Stylus supra medium bifidus. Placentæ 12–14-ovulatæ.

35. P. Davidsonii. Depressa, pube striguloso-hirsuta canescens; foliis spathulato-lanceolatis parce pinnatifidis, lobis 1–2-jugis triangulatis integerrimis cum terminali multo majore oblongo vel lanceolato venis fere parallelis percurso, folio summo sæpius integro; racemis paucifloris; calycis lobis linearibus seu oblanceolatis; corolla violacea lin. 3 longa, plicis semi-ovalibus conspicuis; stylo ad medium usque bifido; placentis 8–10-ovulatis. — Kern Co., California, Davidson.

+– +– +– Folia integerrima, in nonnullis 1–2-dentata vel lobata, petiolata, nec crassiuscula nec cordata, venis subparallelis vel convergentibus, pube haud glandulosa: flores spicato-racemosi: calyx pilis longis patentibus hispidus vel hirsutus: corolla plicis basi latiore filamentis adnatis: capsula ovata, acuta vel mucronata, 6–16-sperma, sepalis multo brevior: semina foveolata.

++ Corolla sat angusta (alba vel pallida), calyce parum staminibus longius superans.

36. P. CIRCINATIFORMIS. *Eutoca phacelioides* Benth. l. c. — Known only in the California collection of Douglas, probably from the vicinity of Monterey. Resembling small and entire-leaved specimens of *P. circinata* in foliage, &c. Corolla 2½ to 3 lines long; fruiting calyx 5 lines long. Ovules 4 or rarely more to each placenta.

++ ++ Corolla lato-campanulata, violacea, genitalia parum aut vix superans.

37. P. CURVIPES Torr. in Wats. Bot. King, p. 252. Diffusa, 2–4-pollicaris, hirsuta et puberula, subcinerea; foliis ovalibus lanceolatisque raro 1–2-lobatis petiolo plerumque brevioribus; racemis simplicibus; pedicellis infimis calyce sæpe longioribus; stylo semibifido; placentis 8–10-ovulatis. — Nevada and adjacent borders of California, Watson, Dr. Horn. Habit of *P. humilis*. Lower pedicels not always curved; so that the specific name is by no means appropriate.

38. P. DIVARICATA. *Eutoca divaricata* Benth. l. c.; Bot. Reg. t. 1784; Bot. Mag. t. 3706. *E. Wrangeliana* Fisch. & Meyer; Don, Brit. Fl. Gard. ser. 2, t. 362. — Common through the western part of California. Flowers rather large, the expanded corolla from two-thirds to three-quarters of an inch broad.

+– +– +– +– Folia integerrima vel crenata, longe-petiolata, venis obsoletis vel divergentibus, pube viscida vel glandulosa: corolla angusto-campanulata fere infundibuliformis, plicis linearibus oblongisve a filamentis inæqualibus fere discretis instructa: stylus apice bifidus. Species eremophilæ, nanæ vel pusillæ.

++ Flores spicæque capituliformes sessilia: folia sat crassa fere avenia.

39. P. CEPHALOTES. A basi divaricato-ramosa, demum fere prostrata, viscido-pubescens; internodiis primariis ramorum 2–4-pollicaribus; foliis oblongis spathulatisve integerrimis circ. semipollicaribus in petiolum sæpe longiorem angustatis plerisque radicalibus et ad bifurcationes congestis spicis capitulisve densis longioribus; sepalis spathulato-linearibus pl. m. hirsutis corollæ angustæ fere infundibuliformi

adæquantibus capsula ovali obtusa 8–10-sperma duplo longioribus; seminibus pellicula reticulata laxa. — *P. curvipes* Parry in Am. Nat. 9, p. 16, non Torr. — S. Utah, Bishop, Mrs. Thompson, Parry. Corolla 2 lines long, white or yellowish, with the short lobes purplish or blue.

++ ++ Flores laxiores pl. m. racemosi: calyx corolla aperto-infundibuliformi vel campanulata brevior, capsula obtusa paullo longior: folia sat crassa, rotundata seu ovalia, venis obscuris.

40. P. DEMISSA. Subspithamæa, a basi ramosa, viscido-puberula, nec hirsuta; foliis obsolete reniformibus cordatisve integerrimis vel repandis (semipollicaribus); floribus in spicis brevi-pedunculatis; petiolis brevioribus pauciusculis; pedicellis brevibus erectis; corolla ut videtur alba (lin. 2 longa) sepalis linearibus duplo longiore; capsula brevi-ovali obtusissima 10-sperma. — New Mexico, Dr. Palmer.

41. P. PULCHELLA. Spithamæa, aperte ramosa, viscido-puberula; foliis rotundo-ovalibus obovatisve integerrimis seu crenato-dentatis (parum semipollicaribus), basi obtusa vel acutiuscula; racemis floribundis elongandis paniculatis; pedicellis calyce brevioribus; corolla læte purpurea (tubo flavida) majuscula (lin. 4–5-longa) sepalis spathulatis triplo longiore; capsula elongato-oblonga obtusissima circ. 30-sperma. — *P. crassifolia* Parry in Am. Nat. l. c., non Torr. — S. Utah, Parry. A showy vernal species, abounding on gypseous clay knolls; the limb of the corolla ampler than in the related species.

42. P. PUSILLA Torr. Exigua, digitalis, demum laxe parce ramosa, glanduloso-pubescens; foliis ovalibus oblongisve integerrimis (lin. 3–6 longis); floribus in racemo laxo paucis; pedicellis filiformibus; corolla alba (vix lin. 2 longa) calyce subduplo longiore; capsula elongato-oblonga obtusa et mucronulata 18–24-sperma. — Wats. Bot. King, p. 253. — W. Nevada to the borders of California, Watson. Seeds somewhat pyriform. Pedicels from 1 to 5 lines long.

++ ++ ++ Flores laxe racemosi: calyx corolla campanulata (alba) brevior, capsula ovali-oblonga subito acutata 60–100-sperma parum longior: folia membranacea, cordato-rotunda, crenato-dentata seu lobata, pl. m. palmativenia, petiolo longo breviora: stylus apice vix bifidus.

43. P. ROTUNDIFOLIA Torr. in Wats. Bot. King, l. c. — S. E. California to S. Utah, Cooper, Palmer, Parry.

§ 7. MICROGENETES. Semina oblonga transversim corrugata, vermiculiformia: cæt. *Eutocæ*. Annuæ, humiles, foliis plerisque pinnatifidis: stamina inæqualia inclusa: stylus apice tantum bifidus.

* HELMINTHOSPERMUM Torr. in herb. Corolla subrotata, plicis 10 faucialibus transversis subcallosis a staminibus longe remotis instructa!

44. P. MICRANTHA Torr. Bot. Mex. Bound. p. 144. Tenera, laxe ramosa, hirsutula, glandulosa; foliorum segmentis 5–9 obovatis oblongisve obtusissimis, imis petiolo marginato, superioribus basi dilatata nunc auriculato-subamplexicaulibus; racemis paniculatis geminatisve perlaxifloris; corolla (sæpius cærulea) sepala accrescentia obovato-spathulata parum superante; capsula globosa 20–24-sperma. — New Mexico, from the Rio Grande, to Arizona and the eastern frontier of California, and S. Utah. The ordinary vertical plicæ rising from the base of the tube of the corolla wholly wanting; but a pair of transverse obtuse folds, high up on the broad tube, stretch from each side of the midvein of the lobes nearly to the lateral vein sent off from its base. Seeds cylindraceous, incurved, very deeply corrugated and tuberculate.

* * MICROGENETES VERA. Corolla infundibuliformis vel cylindracea, sæpius plicis verticalibus angustis basi filamentorum pl. m. adnatis instructa: stylus in nostris inferne pilosulus: semina præter corrugationem minute reticulata. Spec. omnes Am.-Occidentales, una Chilensis. — *Microgenetes* A. DC. *Phacelia* § *Euglypta* Watson, l. c.

+ Corolla (alba seu pallida) calyce parum longior: folia vix bipinnatifida: capsula oblonga 12–24-sperma.

(44ᵃ.) P. CUMINGII. *Eutoca Cumingii* Benth. l. c.; Gay, Fl. Chil. t. 53. *Microgenetes Cumingii* A. DC. l. c. p. 292. — Stylus glaber. Corolla plicis destituta. — Chili.

45. P. IVESIANA Torr. in Ives, l. c.; Wats. Bot. King, p. 254. — Corolla plicis a filamento fere liberis instructa. — Utah to Arizona and the border of California.

+ + Corolla calyce 2–3-plo longior, tubo cum fauce albida vel flavida, limbo sæpissime cæruleo seu violaceo.

++ Folia tantum pinnatifida: racemi spiciformi elongandi: plicæ corollæ filamento longius adnatæ: capsula 20–30-sperma.

46. P. FREMONTII Torr. l. c. — S. Utah and Arizona to California.

++ ++ Folia bipinnatipartita: semina pauciora, breviora, minus corrugata: plicæ corollæ elongatæ angustæ filamento longissime tubulatim adnatæ.

47. P. BICOLOR Torr. in Wats. l. c. — Nevada and adjacent border of California. Corolla unusually long for the subgenus (from 5 to 7 lines):

the narrow adnate plicæ produce a very slender tube behind each filament.

++ ++ ++ Folia dentata vel integerrima: capsula breviora.

48. P. GYMNOCLADA Torr. l. c. Subviscido-pubescens; ramis radicalibus decumbentibus, internodiis elongatis; foliis obovatis oblongisve obtuse dentatis petiolo sæpius brevioribus; spicis plurifloris; corolla breviter infundibuliformi sepalis linearibus hirsutis vix duplo longiore, plicis basi filamenti tubuloso-adnatis; capsula globoso-ovata 8–16-sperma. — W. Nevada, Watson.

49. P. CRASSIFOLIA Torr. l. c. Parvula, a basi diffusa, viscido-pubescens; foliis carnosulis scabridis (lin. 3–6 longis) oblongo-ovatis in petiolum breviusculum angustatis, infimis pauci-dentatis, cæteris integerrimis; racemis laxiusculis paucifloris; corolla infundibuliformi sepalis linearibus duplo longiore, plicis brevibus parvis a filamento fere liberis; capsula ovoidea 6–8-sperma. — Reese-River Valley, Nevada, Watson.

6. EMMENANTHE Benth.

§ 1. MILTITZIA Gray. Annuæ, parvulæ, parvifloræ: sepala sursum latiora: stylus persistens: semina minute reticulata et pl. m. transversim rugosa modo *Microgenetis* (a quo corolla flava marcescenti-persistente facile distincta). — Pac. R. R. Exp. 6, p. 85. *Miltitzia* A. DC.

* Pubescens, sæpissime viscida et glandulosa: corolla breviter 5-loba, plicis 10 angustis inconspicuis per paria filamentis adproximatis basi eorum parum adnatis (in *E. glandulifera* fere evanidis) instructa.

1. E. PARVIFLORA Gray, l. c. t. 15. Depressa, densius pubescens, viscida; foliis profunde pinnatifidis; floribus confertis brevissime pedicellatis; corolla sepalis fere linearibus haud longiore; stylo ovario 20–40-ovulato vix longiore. — Shores of Klamath Lake, Newberry. So far as yet known, this is fairly distinguishable from the next; but the specimens are poor.

2. E. LUTEA Gray, l. c. Diffusa vel decumbens, pube minuta vix glandulosa; foliis oblongis seu obovatis inciso-pinnatifidis dentatisve; floribus conferte racemosis; corolla sepala spathulato-linearia superante; stylo filiformi ovario circ. 12-ovulato multo longiore. — *Eutoca? lutea* Hook. & Arn. Bot. Beech. & Ic. Pl. t. 354. *Miltitzia lutea* A. DC. l. c. *Emmenanthe parviflora* Wats. Bot. King, p. 257. — S. E. borders of Oregon to the eastern borders of California. Hypogynous disk conspicuous, much larger and apparently more free than in the preceding.

3. E. GLANDULIFERA Torr. in Wats. Bot. King, l. c. Tenella, gracilis, pube minuta glandulosa et viscida; foliis parvis oblongis vel spathulatis parum incisis dentatisve, summis integerrimis; floribus in spicis racemisve elongandis numerosis; pedicellis plerumque brevissimis; corolla angusto-campanulata (lin. 2 longa) sepalis linearibus longiore; stylo filiformi; ovulis 6–12. — W. borders of Nevada, Anderson, Watson.

* * Glaberrima, eglandulosa: corolla profunde 5-fida, sepalis oblongo-spathulatis crassiusculis haud longior, plicis nullis: folia succulenta plerumque integerrima: capsula 8–10-sperma, styli basi indurata subulata.

4. E. GLABERRIMA Torr. in Wats. l. c. — W. Nevada and N. Arizona.

§ 2. EMMENANTHE VERA. Major, racemis paniculatis laxis: corolla ampla, latissime campanulata, ochroleuca, plicis nullis: sepala ovato-lanceolata: stylus deciduus: placentæ circiter 8-ovulatæ dilatatæ: semina areolis grossis alveolato-reticulata.

5. E. PENDULIFLORA Benth. — California and S. Utah.

7. CONANTHUS S. Watson (EUTOCA? § CONANTHUS A. DC.)

1. C. ARETIOIDES Wats. l. c. *Eutoca aretioides* Hook. & Arn. l. c.; Hook. Ic. t. 355. — Interior of Oregon to Arizona and eastern borders of California. This little plant is intermediate between *Phacelia* (*Eutoca*) and *Nama*, but nearer to the latter, from which it is excluded mainly by its united styles. The inequality in the insertion of the filaments is not rare in *Nama*, and *N. demissa* is readily mistaken for *Conanthus*. To the latter belongs part of the specimens (those of Anderson) from which I first described *Nama demissa*. *Conanthus* is the only plant of the order in which I have found manifest indications of dimorphism in the genitalia, being of two and perhaps three lengths; the style and stamens, however, not reciprocally long and short, but correspondent, as I have found them in certain *Polemoniaceæ* and *Borraginaceæ*.

8. TRICARDIA Torr.

1. T. WATSONI Torr. in Wats. Bot. King, p. 258, t. 24. — W. Nevada, Watson. I have nothing to add to the characters of this genus, which is strikingly marked by its three cordate enlarged sepals, and of which the specimens extant are scanty.

9. ROMANZOFFIA Cham.

1. R. Unalaschkensis Cham. Haud tuberifera? laxe pubescens vel glabrata; scapo firmiore erecto; pedicellis suberectis flore brevioribus; sepalis herbaceis corolla breviter-infundibuliformi parum brevioribus capsulam subsuperantibus; stylo brevi. — Unalaschka and adjacent islands, Chamisso, Nelson, Harrington, Dall.

2. R. Sitchensis Bongard. Parum pubescens, glabrata; rhizomatibus filiformibus granulato-tuberiferis; scapo debili; pedicellis patentibus flore longioribus; sepalis glabris corolla longiuscule infundibuliformi multum capsula satis brevioribus; stylo filiformi longo. — Sitka to the Coast Range of California, as far south as the Redwoods grow.

10. HESPEROCHIRON S. Watson.

The suggestion that this genus belongs to the *Hydrophyllaceæ* originated with Mr. Bentham. It falls into the *Phaceliæ*, where, however, it finds no near associates, and the inflorescence is anomalous.

1. H. Californicus Wats. Bot. King, p. 281, t. 30. Foliis rosulatis e caudice subcrasso; corolla oblongo-campanulata, lobis tubo brevioribus. — *Ourisia Californica* Benth. Pl. Hartw. *Hesperochiron latifolius* Kellogg in Proc. Calif. Acad.: forma vegetior. — Sierra Nevada, California, to Utah, and Washington Territory.

2. H. pumilus Porter in Hayden, Rep. 1872, p. 768. Foliis paucioribus ex apice rhizomatis gracilioris; corolla fere rotata, lobis tubo intus crebre barbato longioribus. — *Villarsia pumila* Griseb. in Hook. Fl. Bor.-Am. 2, p. 70, t. 157. — Idaho, Northern Utah, and westward. The two species occupy in part the same tract of country, and it remains to be seen if the characters assigned will hold good.

11. NAMA Linn.

The generic name, both in Latin and Greek, is of the neuter gender. A few corrections of my recent synopsis of the species in Proc. Am. Acad. 8, p. 282, need to be made: otherwise there is nothing to add here. Only seven species are known within the limits of the United States. In distinguishing into two species the Berlandieran specimens which Choisy had referred to *N. undulatum*, I took the wrong species for the true *N. undulatum* HBK. The nomenclature and characters have to be rectified thus: —

N. undulatum HBK. Suberectum, mox decumbens; capsula oblonga sepalis pl. m. breviore; seminibus ovalibus, testa tenui diaphana obsoletius striata et scrobiculata. — Var. macranthum Chois. Hydrol.

p. 18, t. 2, f. 1 (*N. Berlandieri* Gray, l. c.): forma laxa; floribus nunc brevissime nunc longiuscule pedunculatis; sepalis corolla subdimidio brevioribus capsula sæpius duplo longioribus. — To the true *N. undulatum* belongs no. 131 of Bourgeau's Mexican collection: it has not been met with in the United States; but the variety, found at Matamoras and Reynosa, probably occurs also on the other side of the Rio Grande.

N. STENOCARPUM. Præcedenti simile; ovario angustiore; capsula fere lineari sepala subæquante; seminibus angulatis nunc fere cubicis, testa crassiore opaca brunnea eximie alveolato-reticulata. — *N. undulatum* Gray, Proc. l. c., quoad pl. Tex.-N. Mex., non HBK. *N. undulatum* Chois. l. c. pro parte. — Texas to Arizona and contiguous parts of Mexico. To this belongs Berlandier's no. 1095, 1435 and 175, 2111 and 694, 2195 and 775, 2328 and 898, and 2525. The seeds are nearly a quarter of a line long, considerably larger than those of *N. undulatum*, and very different in appearance; they are usually angled by mutual pressure, while those of the latter are regularly oval. The styles not rarely cohere to the middle or more, but are separable without rupture.

12. ERIODICTYON Benth.

1. E. TOMENTOSUM Benth. Bot. Sulph. p. 35. — The corollas when well developed are nearly salverform, and twice the length of the calyx. *E. crassifolium* Benth. l. c. was doubtless rightly united with this by Dr. Torrey (in Bot. Mex. Bound. p. 48, &c.), and this name should have been preferred; but the other is good and of the same date.

2. E. GLUTINOSUM Benth. l. c. — *Wigandia Californica* Hook. & Arn. Bot. Beech. p. 364, t. 88. — The filaments are often irregularly and variably adnate to the corolla, sometimes for almost their whole length.

3. E. ANGUSTIFOLIUM Nutt. Pl. Gamb. p. 181. *E. glutinosum* var. *angustifolium* Torr. l. c. — Arizona and S. Nevada to New Mexico. Besides the very narrow and soon revolute leaves, this species has a short-funnelform corolla, only 2 or 3 lines long, sometimes almost campanulate.

13. HYDROLEA Linn.

1. H. CORYMBOSA Ell. Inermis, raro subspinosa, gracilis; foliis lanceolatis brevibus glabris; floribus in cyma terminali corymbiformi; sepalis lineari-lanceolatis villoso-hispidis corolla longioribus; genitalibus longis filiformibus. — S. Carolina to Florida.

2. H. AFFINIS Gray, Man. ed. 5, p. 370. Spinosa, glabra; foliis lanceolatis elongatis subpetiolatis; floribus in glomerulis axillaribus; sepalis ovatis corollæ adæquantibus; stylis capsula brevioribus. — *H. leptocaulis* Featherman in Louisiana Univ. Rep. 1871. — S. Illinois to Texas.

3. H. CAROLINIANA Michx. Subspinosa, parce villoso-hispida; foliis fere glabris lanceolatis brevi-petiolatis; floribus in axillis inferioribus glomerulatis vel in summis solitariis; sepalis linearibus vel sublanceolatis corollam subæquantibus; stylis capsula brevioribus. — *H. quadrivalvis* Walt. Car. p. 110, nomen falsum decipiens. — N. Carolina to Florida.

4. H. OVATA Nutt. in Trans. Am. Phil. Soc. n. ser. 5, p. 196; Chois. Hydrol. t. 1. Spinosa, superne ramosissima, pube undique molli brevi cum pilis longioribus nonnullis; foliis ovatis nunc ovato-lanceolatis brevissime petiolatis; floribus apice ramorum corymboso-congestis; sepalis lanceolatis villoso-hirsutis corolla brevioribus; filamentis stylisque præsertim longis filiformibus. — *H. Ludoviciana* Featherman, l. c. — Arkansas, Louisiana, and Texas. Said to be also South American.

X.

REVISION OF THE GENUS *CEANOTHUS*, AND DESCRIPTIONS OF NEW PLANTS,

WITH A SYNOPSIS OF THE WESTERN SPECIES OF *SILENE*.

BY SERENO WATSON.

Read, March 9, 1875.

1. *Revision of the Genus* CEANOTHUS.

SOME of the species of this exclusively American genus are well marked and readily distinguished, but the larger number are defined with difficulty, and the value of the specific distinctions must still be considered in some cases as uncertain. It would be easy to increase the number of nominal species, as, on the other hand, with apparent reason, to considerably reduce them. But while endeavoring to give a nearly uniform value to the several characters, taking at the same time into consideration our imperfect knowledge of some of the forms, it has seemed best to retain as probably distinct some which seemingly run together, and at the same time to avoid as far as possible proposing new species. The following arrangement is as satisfactory as it could be made with present material and information.

§ 1. EUCEANOTHUS. Leaves all alternate, 3-nerved or pinnately veined, glandular-toothed or entire; fruit not crested.

* Leaves 3-nerved from the base.

+- Erect shrubs, the branches not rigidly divaricate nor spiny; inflorescence thyrsoid; leaves usually large, serrate except in (5).

a. Low (1–3 feet high); flowers white, or sometimes light blue in (5).

1. C. AMERICANA, Linn. More or less villous-pubescent; leaves thin, ovate or oblong-ovate, $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, on short petioles 2–6 lines long; peduncles elongated. — From the Atlantic to Winnipeg Valley, Iowa and Texas.

2. C. OVATUS, Bigel. Nearly glabrous or somewhat pubescent; leaves narrowly oval or elliptic-lanceolate, 1–2 inches long; peduncles usually short; otherwise like the last, into which it seems to pass. — Range the same.

3. C. SANGUINEUS, Pursh. (*C. Oreganus*, Nutt.) Becoming glabrous or nearly so; leaves thin, ovate, 1–4 inches long, on slender petioles 6–15 lines long; peduncles very short; older branches reddish. — From North-western Montana to Washington Territory. The specimens of Nuttall referred here in Torrey and Gray's Flora belong to the preceding species.

4. C. VELUTINUS, Dougl. Stout, usually glabrous; leaves coriaceous, broadly ovate or elliptical, 1½–3 inches long, resinous and shining above, sometimes velvety beneath, glandular-serrulate; petioles stout, 6 lines long; peduncles usually short. — Abundant in the mountains from Colorado to the Columbia and Northern California.

5. C. INTEGERRIMUS, Hook. & Arn. Glabrous or soon becoming so, rarely pubescent; branches terete, usually warty; leaves thin, bright green, ovate to ovate-oblong, 1-3 inches long, entire or very rarely slightly glandular-serrulate, on slender petioles 2–6 lines long; thyrse often large and open, terminating the slender branches, or axillary and rather shortly peduncled, mostly white-flowered. — Frequent in the mountains from Central California to the Columbia River. This will include *C. Californicus* and *Nevadensis* of Kellogg.

Var.? PARVIFLORUS. Of very slender habit, wholly glabrous; leaves much smaller, about half an inch long, short-petioled; flowers light blue, in rather short simple racemes. — In the Sierra Nevada from the Yosemite Valley northward. Possibly distinct, but intermediate forms occur. It is 51 Bridges, 1628 Brewer, 3880 and 4870 Bolander, 68 and 68*a* Torrey, and was also collected by Bigelow and by Dr. Gray.

b. Tall shrubs or small trees, 6–15 feet high; flowers bright blue; leaves oblong to oblong-ovate, rather thick.

6. C. THYRSIFLORUS, Esch. Subglabrous; branches strongly angled; leaves usually smooth and shining above, canescent beneath, glandular-serrulate, 1–1½ inches long; flowers in dense subcompound racemes, terminating the usually elongated and somewhat leafy peduncles. — In the Coast Range, California, from Monterey to Humboldt County, and popularly known as the "California Lilac."

Var.? MACROTHYRSUS, Torrey in Bot. Wilkes' Explor. Exped. 263. This is described as having terete branches; leaves 1–2½ inches long,

grayish tomentose underneath and somewhat silky-villous on the prominent veins, entire, on petioles 3–5 lines long; flowers in elongated, interrupted, somewhat leafy panicles. It was found on the banks of the Umpqua, Oregon, and is probably distinct.

7. C. AZUREUS, Desf. Pubescent; leaves densely rusty-tomentose beneath, smoothish above, 1–2½ inches long; thyrse more open. — Mountains of Mexico from Tepic to Guatemala.

+ + Low, the branches not rigidly divaricate nor spiny; flowers in short simple racemes or pedunculate clusters; leaves small.

a. Eastern species; flowers white.

8. C. MICROPHYLLUS, Michx. Erect, nearly glabrous; branches numerous, slender, leafy, yellowish; leaves thick, very small, 1–2 lines long, fascicled, oblong-elliptic to obovate, entire or sparingly toothed, on very short petioles; flowers in small terminal clusters. — Pine forests of Georgia and Florida.

9. C. SERPYLLIFOLIUS, Nutt. Decumbent, glabrate; branches slender, brownish; leaves less rigid and not fascicled, 3–6 lines long, oblong, serrulate, somewhat hairy beneath; flowers in small clusters on slender axillary peduncles. — Southern Georgia.

b. Western species; flowers blue.

10. C. DENTATUS, Nutt. Erect, hirsutely pubescent, rarely nearly glabrous; leaves ¼–1 inch long, usually small and fascicled, obovate to oblong-elliptic or lanceolate, acute at both ends or obtuse at the apex, glandular-serrate, the margin becoming strongly undulate or revolute; flowers in small roundish clusters, on naked terminal peduncles about an inch long; fruit resinously coated and somewhat triangular, the valves being obscurely costate. — On dry hills in the Coast Range, from Monterey to Mendocino; Douglas, Bigelow, and Brewer (n. 643, 984, and 2374). The larger-leaved form (2392 Bolander) is *C. Lobbianus*, Hook., and will also be the *C. diversifolius* of Kellogg, if any opinion can be formed from his description. The smaller leaves are apparently feather-veined, and often more or less resinous.

11. C. DECUMBENS. Slender, trailing, hirsutely pubescent with spreading hairs; leaves rather thin, flat, ½–1½ inches long, elliptic-oblong, somewhat cuneate at base, obtuse or acutish, glandular-serrate, the greenish glands usually stipitate; flowers in short dense shortly pedunculate racemes, about ½ inch long or less. — Frequent in the mountains of Central California, from the Mariposa Grove northward; collected by Fremont (n. 357), Bigelow (*S. sorediatus* of Whipple's

Report), Stillman, Brewer (n. 1624), Bolander (n. 6331), and Torrey (n. 69).

+– +– +– Erect shrubs, the branches usually rigid, divaricate, or spinose; flowers in simple racemes or clusters; leaves rather small.

a. Rarely or never spinose; leaves glandularly serrulate; flowers mostly blue, racemose.

12. C. HIRSUTUS, Nutt. (*C. oliganthus*, Nutt.) Silky-pubescent with soft subappressed or spreading hairs, or sometimes hirsute, the branches rather rigid and said to be sometimes spinose; leaves ovate to oblong-ovate, usually subcordate or rounded at base and acute at apex, ½–1½ inches long, not smooth above; flowers blue, in simple axillary and terminal racemes 1–3 inches long, or rarely thyrsoid; fruit unknown. — Dry hills about Santa Barbara and in the Santa Susanna mountains; Nuttall, Wallace, Brewer (n. 214, 289, 297, 298).

Var.? GLABER. (*C. sorediatus*, var. *glaber*, Watson in King's Rep. 5. 51.) Glabrous throughout or nearly so; leaves sometimes entire; flowers white. — East Humboldt Mountains, Nevada; Watson (n. 212).

13. C. SOREDIATUS, Hook. Nearly glabrous, the inflorescence pubescent; leaves smooth above, more or less tomentose beneath or rarely nearly glabrous, silky on the veins, oblong-ovate, ½–1½ inches long, subcordate or rounded or often acutish at base, acute or obtuse at the apex; flowers blue, in shortly peduncled simple racemes, ½–2 inches long; fruit unknown. — From San Diego to the Sacramento; Douglas, Bigelow (*S. incanus* of Whipple's Report), Bridges (n. 52), Brewer (n. 286, 1105), and Bolander (n. 4558), — the latter a form with small leaves densely white-tomentose beneath.

b. Branches mostly spinose, grayish; leaves subcoriaceous, usually entire; flowers mostly white, racemose.

14. C. DIVARICATUS, Nutt. Nearly glabrous; leaves oblong-ovate to ovate, ½–1½ inches long, rounded at base, acute or obtuse above, not tomentose beneath; flowers light blue or white, in subsimple often elongated racemes 1–4 inches long. — California, from San Diego northward; Douglas, Nuttall, Coulter (n. 122), Wallace, Bigelow (var. *eglandulosus* and *C. integerrimus* in part, of Whipple's Report), Parry, Cleveland. Also from the "Snake Country," collected by Tolmie.

15. C. INCANUS, Hook. Leaves hoary beneath with a very minute tomentum, broadly ovate to elliptic, ¾–2 inches long, cuneate to cordate at base, acutish or obtuse at apex; flowers in short racemes; fruit over

2 lines in diameter, resinously warty. — Santa Cruz to Lake County, California; "a large straggling shrub on the banks of creeks." Collected by Douglas, Brewer (n. 2663), Bolander (*m.*), Kellogg & Harford (n. 126), and Dr. Gray.

16. C. CORDULATUS, Kellogg, Proc. Calif. Acad. 2. 124, f. 39. Hirsutely pubescent with short erect or spreading hairs; leaves oval-elliptic, ½–1¼ inches long, cuneate to subcordate at base, usually rounded and sometimes serrate at the apex, the serratures scarcely glandular; flowers in short simple racemes, an inch long or less; fruit smaller, not resinously dotted. — In the Sierra Nevada, from the Yosemite Valley northward; "low, flat-topped and much spreading, known as 'snow-bush.'" Collected by Brewer (n. 1630, 1926), Bolander (n. 4892), Bridges (n. 46), Gray and Lemmon.

17. C. FENDLERI, Gray. Silky pubescent; leaves narrowly oblong to elliptic, 4–12 lines long, usually small, somewhat narrowed and cuneate at base, obtuse or acute above; flowers in short terminal racemes. — In the Rocky Mountains from Colorado to New Mexico.

c. Spinose; leaves serrate; flowers in small sessile clusters. Mexican.

18. C. BUXIFOLIUS, Willd. Nearly glabrous, branches slender; leaves rather thin, elliptic, ½ inch long or less, hairy on the veins beneath, sharply serrate; flowers in axillary clusters, the color uncertain. — Mountains of Central and North-western Mexico.

19. C. DEPRESSUS, Benth. Stout and very rigid, tomentose; leaves thick, densely tomentose beneath, elliptical, ½–¾ inch long, mostly rounded at each end, glandular-serrulate; flowers in mostly terminal clusters, color uncertain. — Central Mexico.

* * Leaves pinnately veined. (Forms of *C. dentatus* might be referred to this group.)

20. C. SPINOSUS, Nutt. Becoming a small tree, 20–30 feet high, branchlets rigid and somewhat spiny, glabrous or nearly so; leaves subcoriaceous, entire, oblong, 9–15 lines long, obtuse or retuse, subcuneate at base, on slender petioles 2–4 lines long; flowers deep blue, in a thyrse or in simple racemes, very fragrant; fruit 2½–3 lines in diameter, resinously coated. — From Santa Barbara to Los Angeles, commonly known as "Redwood;" Nuttall, Parry, Brewer (n. 56, 74, 255, 287).

21. C. PAPILLOSUS, Torr. & Gray. More or less subhispidly villous or tomentose, 4–6 feet high; leaves glandularly serrulate, the upper surface glandular-papillose, narrowly oblong, obtuse at each end, 1–2

inches long, on slender petioles; flowers blue, in close clusters or short racemes terminating slender naked peduncles; fruit 1½ lines broad. not resinous. — Coast Range, from Monterey to San Francisco; Douglas, Bolander (*n.*), Dr. Gray.

22. C. FLORIBUNDUS, Hook. Bot. Mag. t. 4806. Pilose-scabrous; leaves small, 3–4 lines long, oblong, acute, glandularly denticulate and undulate, shortly petioled; flowers blue, in dense globose clusters sessile at the ends of the short branchlets. — Known only from the figure and description in the Botanical Magazine; raised from Californian seeds, and closely related to *C. dentatus*.

23. C. VEATCHIANUS, Hook. Bot. Mag. t. 5127. Glabrous nearly throughout; leaves thick, obovate-cuneate, rounded at the apex; glandular-serrate, smooth and shining above, minutely tomentose beneath between the veinlets, 6–9 lines long, on short stout petioles; flowers bright blue, in dense crowded clusters at the ends of the leafy branches. — Likewise known only from figures and descriptions of specimens cultivated in foreign gardens.

§ 2. CERASTES. Leaves mostly opposite, 1-ribbed, with numerous straight parallel veins, very thick and coriaceous, spinosely toothed or entire; flowers in sessile or shortly pedunculate axillary clusters; fruit larger, with three hornlike or warty prominences below the summit. Rigidly branched or rarely spiny shrubs, with small leaves; stipules mostly swollen and warty.

24. C. CRASSIFOLIUS, Torr. Erect, 4–12 feet high, the young branchlets white with a villous tomentum; leaves ovate-oblong, ½–1 inch long, obtuse or retuse, more or less tomentose beneath, rarely entire and revolutely margined, the petioles very thick; flowers light blue or white, in dense very shortly peduncled clusters. — In the Coast Range from Mendocino County to San Diego; Bigelow, Parry, Wallace, Brewer (n. 295), Bolander (n. 4713), and Kellogg.

25. C. CUNEATUS, Nutt. Erect, 3–12 feet high, less tomentose or nearly smooth; leaves cuneate-obovate or -oblong, rounded or retuse above, on rather slender petioles, entire or very rarely few-toothed; flowers white or occasionally light blue, in rather loose clusters. — From the Columbia River to Santa Barbara, by numerous collectors.

26. C. GREGGII, Gray. Closely resembling the last, but more tomentose, and the leaves not cuneate at base; 5 feet high. — From Northern Arizona to New Mexico and Northern Mexico; Gregg, Wright, Bigelow (*C. cuneatus* of Ives's Report), and Bishop.

27. C. RIGIDUS, Nutt. Erect, 5 feet high, the branchlets tomentose; leaves 2–5 lines long, cuneate-oblong or usually very broadly obovate, often emarginate, few-toothed above, very shortly petioled; flowers bright blue, in sessile clusters. — About Monterey and Oakland (?), California; Nuttall, Douglas, Coulter (n. 125), and Hartweg (n. 1680).

28. C. PROSTRATUS, Benth. Prostrate, nearly glabrous; leaves 3–12 lines long, obovate or usually oblong-cuneate, spinose usually only at the apex, on short slender petioles; flowers bright blue, the clusters on stout peduncles. — Frequent in the mountains from Humboldt County and the Upper Sacramento to Mariposa County; found on both slopes of the Sierra Nevada.

2. *Descriptions of New Plants of Various Orders, from the Pacific States and Western Territories, with a Synopsis of the Western Species of* SILENE.

CLEMATIS FREMONTII. Stems stout, erect, clustered, 6–12 inches high, leafy and usually branched, more or less villous-tomentose, especially at the nodes; leaves simple, 3–4 pairs, coriaceous and with the veinlets conspicuously reticulated, sparingly villous, sessile, broadly ovate, entire or few-toothed, acutish, 2–4 inches long; flowers terminal, nodding, the thick purple sepals an inch long, narrowly lanceolate, tomentose upon the margin, recurved at the tip, the peduncles becoming erect in fruit; akenes silky, 3–4 lines long, the tails less than an inch long, naked above, silky at base. — This well-marked species, the western representative of *C. ochroleuca*, was first collected by Fremont (n. 194) on his second expedition, but without note of the locality. It was rediscovered during the past season by Louis Watson, M.D., in the neighborhood of Ellis, Kansas.

CARDAMINE BREWERI. Perennial, glabrous or slightly pubescent at base; stems weak and ascending, usually simple, a foot high; leaves with 1–2 pairs of rounded or oblong leaflets, the terminal one much larger, ½–1 inch or more in diameter, entire or coarsely sinuate-toothed or lobed, obtuse, often somewhat cordate at base, the radical leaves mostly simple and cordate-reniform; petals 2 lines long, white; pods 8–15 lines long, ascending on pedicels 3–4 lines long, obtuse or scarcely beaked with a short style. — This species is allied to the Californian *C. paucisecta*, which has larger flowers and acutely beaked pods on elongated pedicels. *C. hirsuta* and *oligosperma* have more

numerous leaflets, smaller flowers, and more slender acute pods. *C. angulata* from Oregon is well characterized by its 3-foliolate leaves with nearly equal and similar leaflets, its short pods on slender pedicels, and by its slender loose-flowered habit.

Found in the mountains from the northern Sierra Nevada (1890 Brewer, near Sonora Pass at 8–10,000 feet altitude; 235 Anderson, near Carson City, = *C. paucisecta*, var. *angulata* of Anderson's Catalogue of Nevada plants) to Oregon (31 Hall = *C. oligosperma*, Gray in Proc. Am. Acad. 8. 376) and eastward to Wyoming (Hayden, east slope of the Teton Range, Idaho, and on Henry's Fork of the Green River, = *C. paucisecta* of Hayden's Reports for 1870 and 1872).

SILENE MONANTHA. Glabrous; stems very weak, elongated, ascending, branched; leaves narrowly oblanceolate, 1½–3 inches long, acuminate, shortly ciliate at base; flowers terminal on elongated peduncles, not reflexed; calyx inflated, thin and submembranous, 6 lines long, slightly puberulent, the triangular acutish teeth only net-veined, the scarious edge subciliate; petals 9 lines long, apparently pinkish or white, the naked claw very narrowly auricled, limb bifid with broad rounded lobes, coronal appendages lanceolate, entire, half as long as the limb; filaments naked; styles short; ovary oblong, rather long-stipitate.— Collected by Kellogg & Harford (n. 78), growing on the debris at base of Castle Rock, Cascades, Washington Territory. This and the two next following species are the only known western *Silenes* of the group with inflated calyces.*

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* Our western species of *Silene* may be arranged and partially differentiated as follows:—

§ *Annuals.*

1. S. ANTIRRHINA, Linn. Erect, glabrous; flowers small, in an open naked dichotomous panicle.—Throughout the United States.

§§ *Perennials.*

* Dwarf, matted; flowers terminal and solitary.

2. S. ACAULIS, Linn. Alpine and arctic.

* * Calyx campanulate, inflated.

3. S. MONANTHA. Stems weak, elongated; flowers terminal and solitary, long-pedunculate; limb bifid.— Washington Territory. See above.

4. S. CAMPANULATA. Stems erect, dichotomous at the summit; flowers few, pendent; claws and filaments pubescent; limb 4-parted with bifid segments.— North-western California. See p. 341.

5. S. LYALLII. Stems erect, slender; flowers more numerous, in a loose panicle, erect; limb bifid, brownish purple.— Washington Territory. See p. 342

SILENE CAMPANULATA. Glandular-puberulent; stems clustered, from a thick rootstock, erect, 6–10 inches high, simple or dichotomously

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* * * Calyx oblong-cylindric or clavate, expanded by the enlarging capsule.

a. Low and spreading or decumbent; inflorescence leafy; flowers white.

6. S. MENZIESII, Hook. Flowers very small, petals bifid, without corona.— Rocky Mountains to the Pacific.

7. S. WRIGHTII, Gray. Flowers large, subsolitary; petals 4-cleft.—New Mexico.

8. S. HOOKERI, Nutt. (*S. Bolanderi*, Gray.) Flowers very large; petals 4-parted.—California.

b. Erect; panicle naked, usually spreading; petals 4-parted or -cleft.

9. S. LACINIATA, Cav. Flowers very large, bright scarlet; petals deeply 4-cleft, the lateral lobes spreading and shorter; leaves narrowly lanceolate.— Southern California and Mexico.

Var. GREGGII. (*S. Greggii*, Gray.) Leaves oblong-lanceolate to ovate.— New Mexico.

Var. CALIFORNICA, Gray. (*S. Californica*, Dur.) Stem lax, often low and leafy throughout; leaves oblong-lanceolate to ovate; lobes of the petals sometimes cleft.—California.

10. S. LEMMONI. Slender, subglabrous; calyx short, with acute teeth; petals equally 4-parted; capsule nearly sessile.—Northern Sierras. See p. 342.

11. S. OCCIDENTALIS. Stout and tall, glandular; calyx long, with obtuse teeth; petals deeply 4-cleft, the villous claw not auricled; capsule long-stipitate. —Northern Sierras. See p. 343.

12. S. OREGANA. Glandular; petals 2-parted, with filiform bifid lobes; claw very narrow, the auricles produced upwards; capsule long-stipitate.—Oregon. See p. 343.

13. S. MONTANA. Slender, puberulent, the panicle narrower; petals equally 4-cleft, the corona and auricles lacerate; capsule long-stipitate.—Northern Sierras. See p. 343.

14. S. THURBERI. Tall, erect, glandular-pubescent; inflorescence elongated; flowers small; petals narrow, inconspicuous, the short limb cleft to the middle, with smaller lateral lobes, the auricles produced upwards.—New Mexico. See p. 343.

c. Inflorescence similar; petals bifid.

15. S. PECTINATA. Stout and tall, glandular; calyx-teeth long and lanceolate; claw narrow and not auricled.—Northern Sierras. See p. 344.

16. S. INCOMPTA, Gray. Tall, lax, puberulent; leaves broadly lanceolate; calyx-teeth oblong, acute; lobes of the petals often toothed.—Yosemite Valley.

17. S. VERECUNDA. Low, erect, glandular above; leaves narrow; calyx-teeth ovate; claw broad.—Near San Francisco. See p. 344.

d. Flowers usually few, in a naked narrow subracemose panicle; petals bifid, with entire lobes; leaves linear-lanceolate.

18. S. DOUGLASII, Hook. Petals pink, with auricled claws and broad obtuse lobes.—From the Wahsatch to the Sierra Nevada and northward.

branched at the summit; leaves lanceolate, 1–1½ inches long, acute or acuminate; flowers solitary or few, on short deflexed pedicels; calyx campanulate, 5–6 lines long, the teeth broad, obtuse or acutish, and finely net-veined; petals pale flesh-color, 9 lines long, with pubescent scarcely auriculate claws, the limb 4-parted nearly to the base, the lobes bifid to the middle, or the lateral ones entire or notched; appendages oblong, fleshy, entire; filaments pubescent, exserted; ovary suborbicular, shortly stipitate. — Collected on Red Mountain, Mendocino County, California, by Bolander (n. 6517) and Kellogg.

SILENE LYALLII. Glabrous excepting the inflorescence, which is subglandular-puberulent; stems slender, ascending; leaves linear-oblanceolate, 1–2 inches long, the lower attenuate to a slender petiole; flowers in dichotomous few-flowered cymes, the slender pedicels 3–4 lines long, not deflexed; calyx 4 lines long, campanulate, net-veined above, the teeth obtuse, broadly triangular; petals 7 lines long, brownish purple, with an oblong shortly bifid limb, oblong entire appendages, and naked scarcely auricled claw; anthers purple, included; styles very short; ovary small, narrowly oblong. — Collected by Lyall in the Cascade Mts. in 1859, and by Lemmon (n. 16) in Sierra County, California.

SILENE LEMMONI. Glabrous or puberulent, the inflorescence glandular-puberulent; stems erect from a decumbent perennial base, slender, 8–12 inches high, branched; leaves mostly on young shoots, spatulate to oblong-lanceolate, an inch long, acute; flowers in an open dichotomous panicle, erect or at length deflexed, on slender pedicels 4–9 lines long; calyx ovate-cylindric, 4 lines long, net-veined along the main nerves, the teeth acutely triangular; petals rose-color, 6–8 lines long, the broad limb 4-parted nearly to the base, with linear entire or notched lobes, the lanceolate appendages entire, and the villous claw narrowly auricled; ovary oblong, shortly stipitate. —

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19. S. BRIDGESII, Rohrb. Petals white, very narrow, the claw scarcely auricled, and lobes narrowly linear; styles very long exserted. — Yosemite Valley.

e. Inflorescence similar, but flowers more numerous and usually somewhat crowded; stout, erect, and glandular.

20. S. SCOULERI, Hook. Glandular above; leaves narrow; calyx-teeth net-veined; petals conspicuous, the broad bifid limb with notched lobes and appendages; capsule long-stipitate. — Colorado to Oregon.

21. S. SPALDINGII. Viscidly pubescent; leaves numerous, lanceolate; calyx wholly net-veined; petals with a broad claw, a short obtuse notched limb, and 4 short distinct appendages; capsule short-stipitate. — Central Idaho. See p. 344.

Collected by Mr. J. G. Lemmon (n. 17, 18) in Sierra County, California.

Silene occidentalis. Glandular-puberulent, or somewhat tomentose below; stems stout, erect from a vertical rootstock, 2 feet high, branching; leaves oblanceolate, 2–4 inches long, acute, the lower ciliate at base; flowers in an open dichotomous panicle, erect or sometimes nodding, on pedicels 6–15 lines long; calyx cylindrical, 6–8 lines long, net-veined along the main nerves, the teeth ovate, obtuse; petals 9–12 lines long, apparently deep purple, deeply 4-cleft with nearly equal lobes or the lateral smaller, appendages lanceolate and entire, the claw naked and without auricles; filaments slightly exserted; ovary oblong, equalling the stipe. — Collected by Lemmon in Sierra County, California.

Silene Oregana. Viscidly pubescent; stems ascending, simple, a foot high or more; leaves oblanceolate, acute, 1-2 inches long; flowers in an open dichotomous panicle, somewhat nodding upon slender pedicels 3–6 lines long; calyx oblong-cylindrical, 6 lines long, somewhat membranous, with oblong acutish teeth; petals white, 10 lines long, the narrow limb parted to the base and the lobes deeply bifid with filiform segments, the linear appendages entire, and the very narrow naked claw with the auricles produced upward into lanceolate teeth; filaments and styles somewhat exserted; ovary oblong, long-stipitate. — Collected in the Blue Mountains, Oregon, by Rev. R. D. Nevius, 1873.

Silene montana. Puberulent; stems erect from a decumbent perennial base, mostly simple, a foot high; leaves narrowly oblanceolate, 1½–2 inches long, acuminate; flowers in a narrow subdichotomous panicle, erect upon usually short pedicels; calyx cylindrical, 7–9 lines long, the oblong teeth acutish; petals 7–10 lines long, apparently rose-color, the broad limb deeply 4-cleft with equal entire linear segments, claws naked, the auricles and broad ovate appendages somewhat lacerate; filaments scarcely exserted; ovary oblong, the stipe becoming 2 lines long. — Near Carson City, Anderson (n. 107), and also collected by Lemmon at the Big Meadows, Sierra County, California.

A similar but probably distinct form has been collected by Rev. R. D. Nevius in the Blue Mountains, Oregon, having the short quadrate limb barely notched, the coronal appendages and the auricles entire or nearly so, and the carpophore much shorter.

Silene Thurberi. Glandular-tomentose; stems tall, erect; leaves lanceolate, acuminate; flowers small, in a narrow elongated panicle, erect on rather slender pedicels; calyx cylindrical, 6 lines long, with

narrow acute teeth, strongly 10-nerved, net-veined above; petals white, scarcely exserted, the limb bifid with a shorter lobe on each side, the narrow naked claw having the auricles produced upwards as far as the short oblong appendages and somewhat hooded; filaments exserted; styles included; ovary narrowly oblong, shortly stipitate. — Collected only by Dr. Thurber (n. 726) in August, 1852, in arroyos near Janos, near the boundary line of South-western New Mexico.

SILENE PECTINATA. Viscidly pubescent; stems erect, stout, 1½ feet high, simple or branched; leaves lanceolate, acuminate, 1½–2½ inches long, the radical attenuate to a long slender petiole equalling the blade; flowers in a narrow strict or dichotomously branched panicle, erect on pedicels ½–1 inch long; calyx oblong, 6–9 lines long, cleft nearly to the middle, the teeth narrow, acute; petals dark rose or purple, nearly an inch long, the naked claw narrow and without auricles, the broadly oblong limb deeply bifid with obtuse segments, the lanceolate appendages entire; ovary oblong, the capsule nearly sessile — Collected near Carson City by Dr. Anderson (n. 18); in Walker's Meadows by Brewer (n. 1857); and in Plumas County, California, by Mrs. M. P. Ames, and also by Lemmon.

SILENE VERECUNDA. Glandular-pubescent; stems low, clustered, erect, 8–10 inches high, simple; leaves oblanceolate, acute, 1½–2 inches long; flowers few, in a loose panicle, erect upon mostly elongated pedicels ½–1 inch long; calyx oblong-cylindric, 6 lines long, with acutish triangular teeth, net-veined above; petals 9 lines long, rose-colored, the oblong limb cleft to the middle with linear entire lobes, the appendages notched at the apex, and the naked claw narrowly auricled; filaments included; ovary oblong, shortly stipitate. — Near *S. incompta.* Collected only by Bolander (n. 352), on rocky hills near Mission Dolores.

SILENE SPALDINGII. Viscidly tomentose; stems erect, stout, a foot high or more, simple or branched, very leafy; leaves lanceolate to oblong-lanceolate 1½–2 inches long, acutish; flowers in a short strict racemose panicle, nodding or erect; calyx oblong-cylindric, 7–8 lines long, with large triangular-ovate acutish teeth, net-veined to the base; petals scarcely exserted, the broad auricled claw naked, the limb very short and triangular, notched at the apex, and with four small lanceolate appendages at base; filaments and styles included; ovary oblong, shortly stipitate. — Collected only by Spalding on the Clear Water in Central Idaho.

SAGINA OCCIDENTALIS. Annual, glabrous, very slender and deli-

hispid and quite spinulose; stipules oblong-lanceolate; leaves thin, ovate or the upper oblong-lanceolate, 2–4 inches long, acute, subcordate or rounded at base, coarsely serrate, finely hispid beneath, tuberculately roughened above; petioles ½–1½ inches long; flowers in short loose open panicles, scarcely exceeding the petioles; perianth obovate, obtuse, minutely hispid, nearly a line long, twice longer than the broadly ovate achenium. — Los Angeles, California, frequent in waste places (Brewer, n. 95); collected also by Bigelow on the banks of the Limpio in Western Texas (*U. dioica*, Torrey in Bot. Mex. Boundary, in part), and also by Wolf on Lieut. Wheeler's Survey in Southern Colorado.

The only other Californian species of the genus is *U. holosericea* of Nuttall's *Pl. Gambelliana* (the same probably as *U. trachycarpa* of Weddell), which is found near Monterey. It is densely hoary-tomentose, especially on the lower side of the leaves; the oblong stipules acuminate; leaves thick, oblong-lanceolate and acuminate, on short petioles; male flowers in loose slender panicles nearly equalling the leaves, the female more numerous in dense and shorter panicles; perianth ovate, densely hispid, about equalling the small broadly ovate achenium. Eastward of the Sierra Nevada, in Nevada and Southern Utah, the western finely tomentose or velvety form of *U. gracilis* occurs, referred to *U. dioica* in King's Reports, vol. 5, p. 321.

PLATANUS WRIGHTII. Leaves subtomentose beneath, very acutely and deeply 5–7-lobed, the lower lobes projected backwards and forming a deep sinus; petioles ½–5 inches long; racemes not exceeding the leaves; fertile heads three, 8–10 lines in diameter; nutlets glabrous, villous at base, truncate above and tubercled with the short base only of the style; receptacle densely hairy and fruit-bearing over nearly the entire surface. — Collected by Wright (n. 1880) in southeastern Arizona near the San Pedro, and described as a large tree. It is very distinct from the Mexican and Californian species, in regard to which there is still some confusion.

JUGLANS CALIFORNICA. More or less floccose-tomentose or sometimes nearly glabrous; leaflets 5–8 pairs, oblong-lanceolate, acute, narrowing upwards from near the base, 2–2½ inches long; male aments 4–8 inches long, often in pairs; sepals acute or obtuse, veined, 1½ lines long; stamens 30–40, the anthers a line long, with the apex of the connective very short and bifid; fruit globose, slightly compressed, ¾–1 inch in diameter; nut shallowly sulcate, the walls rather thin and with two broad cavities upon each side. (*J. rupestris*, var. *major*, Torrey in Sitgreave's Report, p. 171, t. 16.) — A large shrub

or tree, in the vicinity of San Francisco growing 40–60 feet high and 2–4 feet in diameter, and ranging southward to Santa Barbara, Southern Arizona and Sonora. The more eastern *J. rupestris*, Engelm., is but 6–20 feet high, with more numerous and usually more acuminate leaflets, the aments only two inches long with smaller flowers, 20–30 stamens, shorter anthers and a more prominent connective, the globose nut 6–7 lines in diameter with very thick and nearly solid walls.

Myrica Hartwegi. Diœcious; leaves deciduous, oblanceolate, acute, attenuate to a short petiole, 2 inches long, serrate above, pubescent, especially on the margin, as also the branchlets; staminate spikes solitary, cylindrical, 5–8 lines long, many-flowered; bracts glabrous, brown, imbricated, broadly ovate, acute; stamens 3–4, shorter than the bracts, the filaments united at base; female flowers and fruit unknown. (*M. Gale*, Benth. in *Pl. Hartweg.*) — Collected by Hartweg (n. 1958) on the Sacramento, by Fremont, and on the south fork of the Merced near Clark's Station by Mr. Muir, who describes it as a small bush six feet high. It differs from *M. Gale* (which is not known from south of Alaska on the Pacific Coast) in its larger, thinner, acute and more coarsely toothed leaves, the male aments rather longer and less crowded.

Populus Fremontii. Leaves puberulent, especially upon the margin, subreniform, abruptly acute, rather deeply sinuate-dentate, the many incurved teeth scarcely glandular-tipped; petioles slender, equalling the blade, somewhat flattened above; male aments stout, 4–5 inches long, loose, with slender pedicels 8–10 lines long, and naked laciniately fringed bracts, the torus thick and conspicuous, 3–4 lines broad; stamens 60 or more; fruiting aments 4 inches long, with pedicels 2 lines long, the three stigmas broadly dilated and irregularly lobed; fruit ovate, 3-4 lines long, as broad as the torus, with three very thick finely tuberculate valves, the sutures not prominent. — Collected by Fremont (n. 243, 244 of 1846) on Deer Creek at "Lassens" in the Upper Sacramento Valley. The young branches are light gray, slightly pubescent, not angled. Distinguished especially by the remarkably developed torus.

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of making careful microscopic investigations on the shore, is not conducive to a scientific knowledge of our algæ. Of the coast from New York to Charleston we know very little; but, owing to its sandy character, we are not to expect much. Botanists visiting the Delaware Breakwater, Norfolk, or Wilmington, N.C., would do good service by giving lists of the algæ found there, that the southern limit of several common species might be fixed.

Whatever may be said of the poverty of our eastern coast, Key West outranks even the famous Biarritz for number of species. It is curious to notice the very large per cent of the species in the following list which occur there. The flora of that region is peculiarly West Indian, and has little in common with that of the rest of the United States. We are in almost complete ignorance of the algæ on the coast of the States bordering on the Gulf of Mexico. The Pacific coast far exceeds the eastern in the richness of its flora, and future additions to our algæ will come from this region. Fortunately, the number of botanists in the Pacific States is now tolerably large, and the work of deciding the limits of doubtful species must be accomplished by observers on that shore rather than in eastern herbaria.

The classification followed in the accompanying list is that adopted by Harvey in the Nereis Am.-Bor. Since his day, discoveries have been made with regard to the development of the different groups, which demand a complete revision of Harvey's classification; but this is not the place for instituting such a change. Species not mentioned in the Nereis are denoted by a star. The attention of persons living on the seashore is directed to the italicized questions.

The list is intended to include all the species growing on the shores of the United States *proper*, not including Alaska. Those of Vancouver's Island are only in part enumerated, and some of the following named species mentioned by Harvey, in his article on the Algæ from the North-west Coast, may occur also in our Pacific States: *Cystophyllum Lepidium*, Rupr.; *Carpomitra Cabreræ*, Kütz.; *Agarum fimbriatum*, Harv.; *Laminaria apoda*, Harv.; *Ectocarpus oviger*, Harv.; *Polysiphonia senticulosa*, Harv.; *Cystoclonium gracilarioides*, Harv.; *Callophyllis flabellulata*, Harv.; *Kallymenia reniformis*, Ag.; *Iridæa cordata*, Ag.; *Halymenia ligulata*, Ag.; *Prionitis Lyallii*, Harv.; *Schizymenia? coccinea*, Harv.; *Callithamnion thuyoideum*, Ag.; and *C. subulatum*, Harv.

MELANOSPERMÆ.

FUCACEÆ.

1. Sargassum vulgare, Ag. Wood's Hole, Mass., and southward. — Under this species must be included *S. Montagnei*, Bailey, which is certainly nothing more than a variety.

2. Sargassum affine, Ag. Florida? — *S. platycarpum*, Mont., recognized by the large size of the glands on the leaves, was incorrectly distributed by me as *S. affine* with C. Wright's Cuban Algæ.

3. Sargassum bacciferum, Ag. Gulf Stream, coast of Florida.

4. Sargassum hystrix, Ag. — This species, according to Agardh, ranges from Mexico to Newfoundland. I have specimens from Cuba, collected by *Mr. Charles Wright;* but it must be regarded as extremely doubtful if the species occurs on the New England coast, particularly north of Cape Cod.

5. Sargassum filipendula, Ag. Key West, fide *Prof. D. C. Eaton.*

*6. Sargassum dentifolium, Ag. Key West, *Dr. E. Palmer.* — It is not stated whether this plant was floating or attached. The specimens collected by Dr. Palmer are more luxuriant than those from the Red Sea, but the serrated midrib seems sufficiently characteristic to warrant us in supposing that the species is the same. In a genus containing so many variable species as *Sargassum*, it hardly seems as though the length of the fructifying ramuli and the size of the air-bladders could constitute specific differences.

7. Turbinaria vulgaris, Ag. Key West.

8. Phyllospora Menziesii, Ag. San Diego, Cal., and northward. — Some forms received from San Diego are quite smooth, and the leaflets are serrated, so that this species approaches nearer to *P. comosa* of Australia than has generally been supposed. The smooth lower leaflets easily fall off, and make excellent specimens of *Laminaria.* Most of the specimens of *Laminaria* from Southern California are of this nature. — *How and when does this plant fruit?*

Halidrys siliquosa, Lyngb. — Said to have been found at Newfoundland. As yet no collector, so far as I know, has seen it on the New England coast.

9. Halidrys osmundacea, Harv. San Diego, Cal., and northward. — Extremely variable. It was stated by Ruprecht, and is now generally admitted, that the *Cystoseira expansa* of Agardh is nothing but the tips of this plant. The fruit, in one specimen sent by *Mr.*

Cleveland from San Diego, entirely covers one of the lower leaves, something like the normal state in *Landsburgia quercifolia.*

Cystoseira myrica, Ag. Nassau, *Dr. E. Palmer.* — Will probably be found at Key West.

10. FUCUS (FUCODIUM) FASTIGIATUS, Ag. Pacific coast.

11. FUCUS (OZOTHALLIA, Thuret) NODOSUS, L. East coast. — *Southern limit?*

12. FUCUS DISTICHUS, L. (*F. filiformis*, Gm.) Marblehead, Mass. — Common in the fall. No other locality on our coast yet known, although, probably, not rare.

13. FUCUS FURCATUS, Ag. — Common on the Maine and Massachusetts coast, growing in deeper water than *F. vesiculosus.* This species has the antheridia and spores in the same conceptacles, as is the case with *F. platycarpus*, Thuret, a species not as yet recognized on our coast, although it will probably be found. California, fide *Lenormand.*

14. FUCUS CERANOIDES, L. East coast.

15. FUCUS HARVEYANUS, Dcne. Monterey, Cal.

16. FUCUS VESICULOSUS, L. East and west coasts; North Carolina, *Rev. E. M. Forbes.* — *Southern limit?*

17. FUCUS SERRATUS, L. Newburyport, Mass.; Pictou, N.S. Only two stations in America.

18. HIMANTHALIA LOREA, Lyngb. "Coast of N. America," Ag.

SPOROCHNACEÆ.

This and the remaining orders classed by Harvey in the Melanospermæ are, with the exception of the *Dictyotaceæ*, placed by Thuret in his division *Phæosporæ* (vid. Ann. des Sciences Nat. 3 série, t. 14, 1850).

19. ARTHROCLADIA VILLOSA, Duby. Wilmington, N.C.

20. DESMARESTIA ACULEATA, Lmx. New York northward. — *West coast? Fruit?*

21. DESMARESTIA VIRIDIS, Lmx. New York and northward. — *West coast?*

22. DESMARESTIA LIGULATA, Lmx. Monterey northward.

LAMINARIACEÆ.

23. MACROCYSTIS PYRIFERA, Ag. West coast.

24. NEREOCYSTIS LÜTKEANA, Post. and Rupr. Monterey northward. — *Fruit?*

Lessonia. — Species of this genus certainly exist on the Pacific coast, but of their specific characters we are still as ignorant as in the time of Harvey. Specimens which find their way to the east are too imperfect for determination. Some of the supposed specimens of *Lessonia* are nothing but the bladderless leaves of *Macrocystis*. Others are the young fronds of *Phyllospora*. I have specimens from Oregon, collected by *Mr. E. Hall*, which may belong to *L. fuscescens*, but they are too imperfect to warrant giving a decided opinion.

*25. Pterygophora Californica, Ruprecht. "Pflanzen aus dem nördl. Theile des Stell. Oceans," p. 17, Plate V. Santa Cruz, Cal., and northward. — *May not this prove to be a* Lessonia? *Fruit?*

*26. Postelsia palmæformis, Ruprecht, l. c. p. 19, Plate VI. Santa Cruz, Cal., northward. — *Fruit?*

27. Alaria esculenta, Grev. (inc. *A. Pylaii*, Grev.) Cape Cod northward; north-west coast.

28. Alaria fistulosa, Post. and Rupr. North-west coast.

29. Alaria marginata, Post. and Rupr. North-west coast.

30. Costaria Turneri, Grev. (inc. *C. Mertensii*, Ag.) North-west coast.

31. Dictyoneuron Californicum, Ruprecht, l. c. p. 24, Plate VII. — I have never seen specimens of this plant, but from Ruprecht's figure one might infer that it is a species of *Costaria*. North-west coast.

32. Laminaria fascia, Ag. New York northward. — This belongs to the genus *Phyllitis*, of Le Jolis's "Liste des Algues marines de Cherbourg."

33. Laminaria dermatodea, De la Pyl. Peak's Island, Portland harbor, Me., common just below low-water mark, *W. G. F.;* Eastport, Me., *Prof. D. C. Eaton.* — Recognized by the very short root fibres and flat stipe, gradually expanding into a thick coriaceous frond of lanceolate outline; often, when exposed, splitting to the base of the stipe. *Time and mode of fruiting?*

34. Laminaria saccarhina, Lmx. New York northward. — *Southern limit? West coast?*

35. Laminaria longicruris, De la Pyl. Common from Boston northward. Old Lyme, Conn., *Prof. D. C. Eaton.* — Not always readily distinguished from the last. The hollow stipe is not always diagnostic, since it is only when the plant has attained a certain age that the stipe is hollow. On the other hand, old stipes of *L. saccarhina* are sometimes hollow for a short distance. The stipe of this plant is infested by a species of *Sphæria.* The *Laminaria trilaminata,*

Olney, is a monstrous form of *L. saccarhina*, with abnormal development of the midrib. I have seen a similar monstrosity in *Agarum Turneri.*

36. LAMINARIA DIGITATA, Lam. of Harvey's Nereis Am.-Bor. — Under this head are included two, and possibly three, different species of our coast. One seems to be the *L. flexicaulis*, Le Jolis, of Europe. It is possible that some of the plants belong to *L. Cloustoni*, Edm. *What is the southern limit of the digitate species on our eastern coast?*

37. AGARUM TURNERI, Post. and Rupr. Nahant, Mass., and northward; north-west coast. — *What is the fruit of this plant?* The plate No. V. of the Ner. Am.-Bor. represents this plant as having tetraspores. If such is the case, which is very doubtful, the plant is far removed from *Laminaria*, the fructification of which has been thoroughly studied by Thuret.

Agarum pertusum, Mert., and *A. Gmelini*, judging from the plates in Postels and Ruprecht, are varieties of *A. Turneri.*

38. THALASSIOPHYLLUM CLATHRUS, Post. and Rupr. North-west coast. — *Fruit?*

39. CHORDA FILUM, Stack. New York northward.

40. CHORDA (SCYTOSIPHON) LOMENTARIUS, Lyngb. Whole eastern coast. — *California?*

DICTYOTACEÆ.

Haliseris. — I have no specimens from the United States, but no doubt some of the West Indian species, as *H. Justii*, *plagiogramma*, *delicatula*, &c., occur on our coast.

41. PADINA PAVONIA, Lmx. North Carolina, fide *Rev. M. A. Curtis;* and southward. — *Northern limit?*

P. Durvillæi, Bory. — Possibly only a form of the last. May be expected in Southern California, as it occurs in Magdalena Bay, where it was collected by the Hassler Expedition.

42. ZONARIA FLAVA, Ag. San Diego, Cal., *Mr. D. Cleveland.*

*43. ZONARIA INTERRUPTA, Ag. California, Australia, *C. B. S.*

44. ZONARIA LOBATA, Ag. Key West.

45. TAONIA? SCHRŒDERI, Ag. Florida, *Dr. E. Palmer.*

46. DICTYOTA FASCIOLA, Lam. Florida.

47. DICTYOTA DICHOTOMA, Lam. Charleston, S.C., and southward.

48. DICTYOTA CILIATA, Ag. Key West.

Dictyota crenulata, Ag. Was collected in Cuba by *Mr. C. Wright.* It probably will be found at Key West.

Dictyota Brongniartii, Ag. Nassau, *Dr. E. Palmer.*

49. STILOPHORA RHIZODES, Ag. Long Island Sound; Wood's Hole, Mass.

50. STILOPHORA PAPILLOSA, Ag. Chesapeake Bay.

51. DICTYOSIPHON FŒNICULACEUS, Grev. L. I. Sound northward.

52. STRIARIA ATTENUATA, Grev. Flushing, L. I.

53. PUNCTARIA LATIFOLIA, Grev. New York northward.

Var. *Zosteræ*, Le Jolis. (*P. tenuissima*, Harv. Ner.) Same limits.

54. PUNCTARIA PLANTAGINEA, Grev. Orient Pt., L. I., *W. G. F.*; Boston, *Mr. G. B. Emerson.*

*55. ASPEROCOCCUS COMPRESSUS, Griff. Gloucester, Mass. Collected by *Mrs. J. T. Lusk.* Europe.

56. ASPEROCOCCUS SINUOSUS, Bory. Key West; San Diego, Cal., *Hassler Exp.*

57. ASPEROCOCCUS ECHINATUS, Grev. Fisher's Island, N. Y., *W. G. F.*; Boston, *Mr. G. B. Emerson.*

58. HYDROCLATHRUS CANCELLATUS, Bory. Florida.

CHORDARIACEÆ.

59. CHORDARIA FLAGELLIFORMIS, Ag. New York northward.

*60. CHORDARIA ABIETINA, Rupr. mscr. Not hitherto published. — Fronds gregarious or solitary, 3–6 inches long; root scutate; main axis slightly compressed, and surrounded on all sides by radiating ramuli, 1–2 inches long, tapering at both ends, narrowly linear in outline, solid when young, tubular when old. Related to *C. flagelliformis*, but easily distinguished by the greater width and compression of the axis, and shortness of the ramuli, which are of nearly uniform length, by the substance, which is much softer than in *C. flagelliformis*, and the lighter color. It adheres to paper. Oregon, *Mr. E. Hall*; California.

61. CHORDARIA DIVARICATA, Ag. New York to Cape Cod; Cape Ann, Mass.

Mesogloia. — Three species are mentioned by Harvey as occurring on our east coast. Of these, —

62 & 63. MESOGLOIA VERMICULARIS, Ag., is a true *Mesogloia*, and is occasionally found on Cape Ann, Mass. *M. virescens* and *M. Zosteræ*, of the Nereis, belong to the genus *Castagnea*, Derb. and Sol., and their occurrence on our northern shores needs confirmation. M. VIRESCENS occurs at Key West. The species of this genus, as well as of the *Ectocarpaceæ*, can be well determined only when fresh or in alcohol, or some of the ordinary preservative fluids. Sterile specimens are almost worthless.

64. LIEBMANNIA LEVEILLEI, Ag. West coast.—This is to be expected at Key West.

65. LEATHESIA TUBERIFORMIS, Gray. New York northward.

*66. RALFSIA VERRUCOSA, Aresch. Portland harbor, Me.; Marblehead and Nahant, Mass., *W. G. F.* Not mentioned by Harvey, but probably common on the New England coast. Europe.

67. ELACHISTA FUCICOLA, Fr. New England coast. Common.

68. MYRIONEMA STRANGULANS, Grev. On Ulva. Fisher's Island, N.Y., *W. G. F.*

ECTOCARPACEÆ.

69. CLADOSTEPHUS VERTICILLATUS, Ag. New England coast.

70. CLADOSTEPHUS SPONGIOSUS, Ag. With the last.

71. SPHACELARIA CIRRHOSA, Ag. New York northward.

72. SPHACELARIA RADICANS, Dillw. Peak's Island, Portland, Me.; Nahant, Mass.; Noank, Conn., *W. G. F.*

73. MYRIOTRICHIA FILIFORMIS, Harv. Penobscot Bay; Rhode Island, *Mr. S. T. Olney.*

Ectocarpus. — Specimens of this genus are worthless unless in fruit. They should be kept in fluid. Of the two kinds of fruit, *trichosporangia*, or multilocular sporangia, and *oösporangia*, or unilocular sporangia, only the former have been observed in this country, unless *E. oviger*, Harv., from California, be the oösporangial state of some species, as one might infer from Harvey's drawing in the Herbarium of Trinity College, Dublin.

74. ECTOCARPUS BRACHIATUS, Harv. Boston northward.

75. ECTOCARPUS FIRMUS, Ag. (*E. littoralis*, Harv. in Nereis Am.-Bor.) New England coast.

76. ECTOCARPUS LONGIFRUCTUS, Harv. Penobscot Bay.

77. ECTOCARPUS SILICULOSUS, Lyngb. Charleston, S.C., northward.

78. ECTOCARPUS AMPHIBIUS, Harv. New York.

79. ECTOCARPUS VIRIDIS, Harv. Charleston, S.C., and northward.

80. ECTOCARPUS LUTOSUS, Harv. Greenport, L.I.

81. ECTOCARPUS TOMENTOSUS, Lyngb. Boston northward.— Some forms of *E. siliculosus* resemble this.

82. ECTOCARPUS FASCICULATUS, Harv. Rhode Island.

83. ECTOCARPUS GRANULOSUS, Ag. Boston.

84. ECTOCARPUS MITCHELLÆ, Harv. Nantucket.

85. ECTOCARPUS DURKEEI, Harv. Portsmouth, N.H.

86. ECTOCARPUS LANDSBURGII, Harv. (?) Halifax, N.S.

87. Ectocarpus Hooperi, Harv. (?) Greenport, L.I.

88. Ectocarpus Dietziæ, Harv (?) Greenport, L.I.

The last four species seem to have been founded by Harvey on single or infertile specimens, a mode of proceeding against which he carefully warned others. An examination of the authentic specimens in the Herbarium of Trinity College, Dublin, convinced me that it would be next to impossible to recognize the two last-named species. Specimens distributed by American collectors under any of the names in question should be regarded with great suspicion.

RHODOSPERMÆ.

The older name *Florideæ* of Agardh should be restored to this very natural group, which, since the discovery by MM. Thuret and Bornet of their mode of fertilization (vid. Ann. des Sciences Nat. 5 série, t. 7), must be considered the most highly organized of the algæ.

RHODOMELACEÆ.

89. Amansia multifida, Lmx. Key West.

Odonthalia dentata, Lyngb. Halifax, N.S. — Probably occurs on the coast of Maine.

*90. Odonthalia aleutica, Ag. Oregon.

*91. Odonthalia Lyallii, Harv. Vancouver's Island.

92. Alsidium Blodgettii, Harv. North Carolina, *Mr. Forbes;* and southward.

93. Alsidium (Bryothamnion, Ag. Spec.) triangulare, Ag. Key West.

*94. Bryothamnion Seaforthii, Ag. Florida, *Dr. E. Palmer;* West Indies.

95. Acanthophora Thierii, Lmx. Florida.

96. Acanthophora Delilei, Lmx. Florida.

*97. Acanthophora muscoides, Ag. Florida, *Dr. E. Palmer.*

98. Chondria (Chondriopsis, Ag. Spec. Alg.) dasyphylla, Ag. Cape Cod southward.

99. Chondria striolata, Ag. (inc. *C. Baileyana*, Mont.) Cape Cod southward.

100. Chondria tenuissima, Ag. Long Island Sound; Boston?

101. Chondria littoralis, Harv. Wood's Hole, Mass., *W. G. F.;* Florida.

102. Chondria atropurpurea, Harv. Charleston, S.C., southward; California!

103. CHONDRIA NIDIFICA, Harv. Pacific coast.

104. RHODOMELA LARIX, Ag. Oregon, *M. E. Hall.*

105. RHODOMELA FLOCCOSA, Ag. (inc. *R. pilulifera*, Grev.) Oregon.

106. RHODOMELA SUBFUSCA, Ag. New York northward.

Var. GRACILIS (*R. gracilis*, Ner. Am.-Bor.) more common north of Cape Cod.

Var. ROCHEII (*R. Rochei*, Ner. Am.-Bor.), spring, more common in Long Island Sound.

107. DIGENIA SIMPLEX, Ag. Key West.

108. POLYSIPHONIA URCEOLATA, Grev. New York northward; California.

Var. FORMOSA. Same limits.

109. POLYSIPHONIA HAVANENSIS, Mont. Agardh includes under this species *P. Binneyi*, Harv. Florida.

110. POLYSIPHONIA FERULACEA, Ag. (inc. *P. breviarticulata*, Harv.) Key West.

111. POLYSIPHONIA SUBTILISSIMA, Mont. Jackson's Ferry, West Point, N.Y.; Providence, R. I.; Newburyport, Mass.

112. POLYSIPHONIA SECUNDA, Ag. Key West.

113. POLYSIPHONIA FRACTA, Harv. Key West.

114. POLYSIPHONIA ECHINATA, Harv. Key West.

115. POLYSIPHONIA HAPALACANTHA, Harv. Key West.

116. POLYSIPHONIA GORGONIÆ, Harv. Key West.

117. POLYSIPHONIA OLNEYI, Harv. New York northward.

118. POLYSIPHONIA HARVEYI, Bail. New York northward.

Var. ARIETINA. Nahant, Mass., *W. G. F.* — *Northern limit?* It is probable that Nos. 117 and 118 should be united with *P. spinulosa*, Grev., found in the north of Scotland, and on the shores of the Adriatic and Mediterranean. The only opportunity I have had for examining the last-named plant living was at Antibes, France. There can have been no mistake in the species, as it was determined by M. Thuret, the highest authority. I must confess that I could see no difference between *P. spinulosa* and our own *P. Harveyi*. It is to be regretted that *P. spinulosa* is not more common, so as to afford more ample means for comparison. As to the two forms, *P. Olneyi* and *P. Harveyi*, I feel obliged to regard them as varieties of one species, since, although I have had excellent chances for observing both forms growing, I have found so many intermediate states that I am quite unable to draw the line. My friend, Prof. D. C. Eaton, with excellent opportunities for observing both forms, has had a similar experience.

Furthermore, the variety *arietina*, considered by Bailey a good species, differs more from the typical form of *P. Harveyi* than does *P. Olneyi*; and, if we are to regard *P. Olneyi* as a species, we must also separate *P. arietina*, as well as several other varieties, — a division by all means to be avoided. The description of *P. subcontorta*, Peck, answers perfectly to *P. Harveyi*.

119. Polysiphonia hirta, Ag. (*P. ramentacea*, Harv.) Key West.

120. Polysiphonia elongata, Grev. Lynn, Mass.; Vineyard and Long Island Sounds. Common.

121. Polysiphonia violacea, Grev. New York northward.

122. Polysiphonia fibrillosa, Grev. Noank, Conn.; Orient Point, L.I.

*123. Polysiphonia pennata, Ag. on *Gelidium cartilagineum*. San Diego, Cal., *Mr. D. Cleveland*; Southern Europe.

124. Polysiphonia parasitica, Grev. Rhode Island.

*125. Polysiphonia dendroidea, Mont. Considered by Agardh a variety of the above, is common in California. Originally from Peru and west coast of South America. The Californian specimens are very luxuriant, and I had formerly erroneously supposed them to be the *Rytiphlæa? Baileyi* of Harvey.

126. Polysiphonia Baileyi, Ag. (*Rytiphlæa?* Harv.) Pacific coast. To the naked eye not very unlike some states of *Rhodomela floccosa*.

127. Polysiphonia Pecten Veneris, Harv. Florida.

128. Polysiphonia exilis, Harv. Key West.

129. Polysiphonia atrorubescens, Grev. New York to Cape Cod.

130. Polysiphonia bipinnata, Post. and Rupr. West coast. — Under this name, Agardh, in his Spec. Alg. p. 1040, includes *P. Californica*, Harv., and *Polyostea gemmifera*, Rupr. Alg. Ochot. Harvey was not of the opinion that *P. Californica* and *P. gemmifera* should be united, inasmuch as he distributed specimens of both species in the algæ of the North Pacific Expl. Exp. under Capt. John Rodgers. Under *P. Californica*, Harvey includes, however, two sets of specimens, — those originally from California, to which he gave the manuscript name of *P. plumigera*, and those collected by the Rodgers Expedition. The former are much coarser than the latter, and do not adhere well to paper. A cross-section of the larger branches shows distinctly fourteen peripheral cells, agreeing with the figure of *P. gemmifera*, Rupr. Alg. Ochot. Plate 11, ag. The specimens collected by Mr. E. Hall in Oregon,

which I formerly distributed under the name of *P. Californica*, agree perfectly with the type specimens of Harvey in aspect, and also show fourteen peripheral cells in a cross-section. The specimens of the Rodgers Expedition adhere well to paper, and bear some external resemblance to certain forms of *P. urceolata*. A cross-section of the stem shows eleven and twelve peripheral cells, and agrees well with a specimen from California presented to me by Prof. Eaton, where a cross-section of the lower part of the frond shows eleven cells. Both the latter show on lateral view six or seven cells; and, as is also the case with Harvey's type specimens, they are often spirally twisted, as in *P. atrorubescens*. The length of the articulations — a specific character, as it seems to me, of very little value in Polysiphonia — is variable. The shape and position of the conceptacles in the specimen given me by Prof. Eaton are very much the same as in the figure of *P. gemmifera* above quoted. Harvey's specimens of *P. gemmifera*, as far as I can see, do not differ from those of *P. Californica* of the Rodgers Expedition, except in being shorter, and in the fact that the ultimate divisions of the frond are incurved. I think almost any one would agree with Agardh in thinking that the *P. gemmifera* of Ruprecht is not specifically distinct from his *P. bipinnata*, which is the older of the two and must take precedence. Under *P. bipinnata* are therefore clearly included the Rodgers Exp. specimens of *P. Californica* and *P. gemmifera*, and the specimen of Prof. Eaton. As to the type specimens of *P. Californica* and Hall's Oregon specimens, although coarser, and differing in aspect from the others, I can find no definite character by which to separate them, since the number of peripheric cells is hardly ever constant when they exceed ten. In this case, Harvey says they are about ten in number, and Agardh twelve, whereas I certainly found fourteen in a specimen of Harvey's. The plan of ramification is the same in each. At any rate, they do not differ from one another more than the forms correctly included under *P. violacea* of the east coast. Without a long experience on the Pacific coast, it seems to me unsafe to consider that *P. Californica* is any thing more than a variety of *P. bipinnata*, Rupr. I might here remark that the difference in aspect between an alga mounted in fresh and one of the same species mounted in sea water is very great; *e.g.*, *P. violacea*. With regard to the specimens in question, I have no means of knowing how they were prepared.

131. Polysiphonia Woodii, Harv. West coast. — Very distinct. Compressed, showing usually 18–20 peripheral cells in cross-sections, decidedly more than in *P. bipinnata*. On a lateral view, the cells are not parallel, but converge towards the base, somewhat as in *P. para-*

ich it is easily distinguished by its ramification, which is
icrocladia.

siphonia nigrescens, Grev. East and west coasts.

siphonia verticillata, Harv. California.

ysiphonia fastigiata, Grev. New York northward.

trychia Montagnei, Harv. Key West.

trychia calamistrata, Mont. Key West.

strychia rivularis, Harv. Isle of Shoals, N.H., to

strychia Tuomeyi, Harv. Florida.

strychia Moritziana, Mont. Florida, *Dr. E. Palmer;*
d West Indies.

asya Gibbesii, Harv. Key West.

asya elegans, Ag. Key West.

asya ramosissima, Harv. Key West.

asya Harveyi, Ashmead. Key West.

asya mollis, Harv. Key West.

asya mucronata, Harv. Key West.

asya Wurdemanni, Bailey. Key West.

asya callithamnion, Harv. San Diego, Cal., *Mr. D.*
l. — Differs from *D. Wurdemanni,* in showing on cross-sections
r cells surrounding a central cell.

Dasya Tumanowiczi, Gatty. Key West.

Dasya lophoclados, Mont. Key West.

Dasya plumosa, Bail. & Harv. West coast.

ya coccinea, Ag., a common European species, is said to have
und on the coast of Maine.

LAURENCIACEÆ.

. Laurencia pinnatifida, Lmx. California.

. Laurencia virgata, Ag. California.

. Laurencia obtusa, Lmx. Florida, California.

. Laurencia implicata, Ag. Key West.

. Laurencia cervicornis, Harv. Key West. Not referred
Agardh in his Spec. Alg.

3. Laurencia gemmifera, Harv. Florida.

7. Laurencia papillosa, Grev. Florida.

3. Laurencia paniculata, Ag. Key West, *Dr. E. Palmer.*

9. Champia parvula, Harv. Long Island Sound. Common. —
hern limit?

C. salicornoides, Harv., is only a variety of *C. parvula*, found occasionally in Long Island Sound as well as at Key West.

160. LOMENTARIA OVALIS, Endl. California. Have not some of the smaller forms of *Prionitis lanceolata*, Harv., been distributed as *L. Coulteri?*

161. LOMENTARIA? SACCATA, J. Ag. California.

CORALLINACEÆ.

As yet we have no good definite characters by which to distinguish the genera and species of this order. The following so-called species include the forms known to exist on our coast.

162. CORALLINA OFFICINALIS, L. Very common from New York northward; California and Oregon.

*163. CORALLINA SQUAMATA, Ellis and Sol. California.

164. JANIA RUBENS, Lmx. Key West.

165. JANIA CUBENSIS, Mont. Key West.

166. JANIA CAPILLACEA, Harv. Key West.

167. AMPHIROA FRAGILISSIMA, Lmx. Florida.

168. AMPHIROA DEBILIS, Kütz. Florida.

169. ARTHROCARDIA FRONDESCENS, Aresch. (*Corallina*, Post. and Rupr.) Judging from Ruprecht's figure, this seems to be a common Californian species, and that described in the Nereis Am.-Bor. as *Amphiroa Californica*, Dcne.

*170. MELOBESIA MEMBRANACEA, Lmx. East coast.

*171. MELOBESIA FARINOSA, Lmx. With the last.

*172. MELOBESIA PUSTULATA, Lmx. With the last.

*173. LITHOTHAMNION POLYMORPHUM, Aresch. Coast of Maine, *Mr. Burgess, Prof. D. C. Eaton.*

SPHÆROCOCCOIDEÆ.

174. GRINNELLIA AMERICANA, Harv. Long Island Sound.— *Northern and southern limits?*

175. DELESSERIA SINUOSA, Lmx. Long Island Sound northward.

*176. DELESSERIA QUERCIFOLIA, Bory. California.

*177. DELESSERIA ANGUSTISSIMA, Griff. Gloucester, Mass.

178. DELESSERIA ALATA, Lmx. Boston northward.

*179. DELESSERIA WOODII, Ag., Bidrag. Vancouver's Island.

180. DELESSERIA HYPOGLOSSUM, Lmx. Charleston, S.C., and southward.

181. DELESSERIA TENUIFOLIA, Harv. Key West.

182. Delesseria involvens, Harv. Key West.

183. Delesseria Leprieurii, Mont. West Point, Jackson's Ferry, N.Y.; and in brackish water southward.

*184. Delesseria decipiens, Ag., Bidrag. (*D. hypoglossum*, var. *arborescens*, Harv.) Vancouver's Island.

*185. Delesseria intermedia, Ag., Bidrag. Vancouver's Island.

186. Nitophyllum punctatum, var. *ocellatum*, Grev. Smithville, N.C.; Key West.

187. Nitophyllum laceratum, Grev. California.

*188. Nitophyllum latissimum, Ag., Bidrag. (*Hymenena*, Harv.) Vancouver's Island.

189. Nitophyllum Fryeanum, Harv. California.

*190. Nitophyllum (Neuroglossum) Andersonii, Ag. mscr. California.

191. Nitophyllum Ruprechtianum, Ag., Bidrag. (*Hymenena fimbriata*, Post. and Rupr.) West coast. — *Southern limit?*

192? Nitophyllum fissum, Ag., Bidrag. (*Hymenena fissa*, Harv.) — The *Botryoglossum platycarpum* of the Nereis Am.-Bor. is, without doubt, the same plant as *Hymenena fimbriata*, Post. and Rupr., which sometimes has an expanse of two feet. I have received specimens from Oregon, where the tetraspores are arranged in a network over the frond, as in *Hymenena fissa*. Harvey says, however, in some specimens of *Botryoglossum*, he has seen on the same individual tetraspores forming a network, and also in marginal leaflets. Applying these remarks to *Hymenena fimbriata*, which was in reality the plant of which Harvey was speaking, we must infer that there is a very strong probability that the American specimens of *Hymenena fissa* are nothing but states of *H. fimbriata*, Post. and Rupr. = Nitophyllum Ruprechtianum, Ag., Bidrag.

193. Calliblepharis ciliata, Kütz. Cape Ann, Mass., and northward. Not common.

194. Gracilaria multipartita, Ag. East and west coasts.

Var. angustissima. — I can hardly believe that this is really a form of *G. multipartita*, unless it be supposed that *G. compressa*, Grev., is also a variety of the same species. The variety is very common in Long Island Sound, and certainly has more the aspect of *G. compressa* than of *G. multipartita*.

195. Gracilaria compressa, Grev. Key West.

196. Gracilaria cervicornis, Ag. Key West, *Dr. E. Palmer*.

197. Gracilaria confervoides, Grev. Charleston, S.C., southward; California, Oregon.

198. Gracilaria armata, Ag. Key West.

199. Gracilaria divaricata, Harv. Key West.

200. Gracilaria Poitei, Lmx. Key West.

201. Gracilaria damæcornis, Ag. "Atlantic coast of North America."

202. Gracilaria? Blodgettii, Harv. Key West.

Gracilaria Wrightii, Ag., has been found in Cuba, and may be expected at Key West.

GELIDIACEÆ.

203. Gelidium corneum, Lmx. Florida, *Dr. E. Palmer;* California.

Var. crinale. Charleston, S.C.; New Haven, Conn.; Wood's Hole, Mass.; Portland, Me. — M. Bornet has shown that under the name of *G. corneum* are included plants belonging to quite different species, as shown by the arrangement of the placenta.

204. Gelidium cartilagineum, Grev. California.

205. Gelidium Coulteri, Harv. California.

206. Wurdemannia setacea, Harv. Key West.

207. Eucheuma isiforme, Ag. Key West.

208. Hypnea musciformis, Lmx. Wood's Hole, Mass., southward; California.

209. Hypnea? crinalis, Harv. California.

210. Hypnea divaricata, Grev. Key West.

211. Hypnea cornuta, Ag. Key West.

SPONGIOCARPÆ.

212. Polyides rotundus, Grev. New York northward.

SQUAMARIÆ.

213. Peyssonnelia Dubyi, Crouan. Key West. — Is not *P. imbricata*, Kütz., said to have been found at Newfoundland, more probably a *Ralfsia?*

*214. Hildenbrandtia rosea, Kütz. Common on stones all along the New England coast. — I can only distinguish one species on our shores. In the list of algæ published in the Report of the United States Fish Commission for 1871, this species was erroneously supposed to be *H. rubra*, Menegh.

HELMINTHOCLADIÆ.

215. HELMINTHORA DIVARICATA, Ag. Key West.

216. NEMALION MULTIFIDUM, Ag. Watch Hill, R.I., and northward.

217. SCINAIA FURCELLATA, Bivon. Newport, R.I.; Gay Head, Mass., &c.

Var. UNDULATA, Ag. (*Halymenia undulata*, Mont.), of Chili, very much more robust, and quite different in aspect from the type, but still not to be separated by any well-defined character, was found at San Diego, Cal., *Mr. D. Cleveland.*

218. LIAGORA VALIDA, Harv. Florida.

219. LIAGORA PINNATA, Harv. Florida.

220. LIAGORA LEPROSA, Ag. Key West.

221. LIAGORA PULVERULENTA, Ag. Key West.

WRANGELIACEÆ.

222. WRANGELIA PENICILLATA, Ag. Key West.

*223. WRANGELIA MULTIFIDA, Ag. Key West; Europe. — Although generally placed together in the same genus, these two species have different kinds of fruit.

RHODYMENIACEÆ.

224. RHODYMENIA PERTUSA, Ag. Vancouver's Island.

225. RHODYMENIA PALMATA, Grev. New York northward; North Carolina, fide *Rev. M. A. Curtis.*

226. RHODYMENIA PALMETTA, Grev. Halifax, N.S. Not yet noticed in New England. California.

227. RHODYMENIA CORALLINA, Grev. San Diego, Cal. — Specimens of a *Rhodymenia*, belonging to the subgenus *Palmetta*, have been sent me from San Diego, Cal. The tetraspores are borne on the expanded tips of the frond, and I have little hesitation in naming them *R. corallina*, as they resemble so closely the figure of Bory. Voy. Coq. pl. 16.

228. EUTHORA CRISTATA, Ag. Nahant, Mass., northward. Common. Dredged in deep water, off Block Island, by the United States Fish Commission.

229. PLOCAMIUM COCCINEUM, Lyngb. West coast. Common. Very rare on the east coast.

Var. SINUOSUM, H. & H., resembling *P. cornutum*, but having the

ramuli in sets of 3–5, as in *P. coccineum*, occurs at San Diego, Cal., *Mr. D. Cleveland.*

230. Rhabdonia Coulteri, Harv. West coast.

231. Rhabdonia tenera, Ag., Bidrag. — According to Agardh, the *Solieria chordalis* of Harvey in Nereis Am.-Bor. is, in reality, *Rh. tenera*, Ag. The plate, No. XXIII. A. fig. 4, of the Ner. Am.-Bor., is incorrect, as there is an opening to the fruit cavity. The structure of this plant deserves farther study.

232. Cordylecladia? Huntii, Harv. Narragansett Bay.

233. Cordylecladia? irregularis, Harv. — This is probably the *Chylocladia rigens*, Ag. Spec. Alg. of the West Indies.

CRYPTONEMIACEÆ.

234. Stenogramma interrupta, Mont. California, Key West. — There has been much discussion about the tetraspores of this plant. They are scattered in sori over the surface, as seen in Californian specimens, and were described by Montagne, in Ann. Nat. Hist., ser. 2, vol. 7; and Harvey, in the Ner. Am.-Bor., speaks of receiving them from Miss Gifford, a fact of which *Mr. E. W. Holmes* does not seem to be aware (vid. *Grevillea*, Dec. 1874).

235. Phyllophora Brodiæi, Ag. L. I. Sound northward.

236. Phyllophora membranifolia, Ag. Same limits.

*237. Phyllophora Clevelandii, n. sp. Caulescens stipite cylindraceo ramoso flexuoso, ramis in laminas planas ovato-lànceolatas, simplices vel cuneatas cum proliferationibus terminalibus expansis. Frondes a basi unilateraliter incisæ in partem angustam quae continuatio stipitis videtur. San Diego, Cal., *Mr. D. Cleveland.* — Distinguished by the large size of the more commonly simple fronds, which are from two to four inches long by one broad, and the narrow proliferation from the base of the laminæ, which seems like a continuation of the stipe.

238. Gymnogongrus Torreyi, Ag. A narrow variety of *G. Norvegicus.* New York.

239. Gymnogongrus tenuis, Ag. California. Also found in the West Indies, and therefore to be expected at Key West.

*240. Gymnogongrus Griffithsiæ, Ag. California, fide *Prof. D. C. Eaton.* Common in Europe, but not seen on our east coast.

241. Gymnogongrus Norvegicus, Ag. Penobscot Bay, Me., *Mr. J. Hooper;* Nahant, Mass., washed ashore; Peak's Island, Portland harbor, Me., in deep pools, Sept. 1874, *W. G. F.* I have seen

no Californian specimens which, it seemed to me, belonged certainly to this species.

242. AHNFELTIA PLICATA, Fr. New York northward; west coast. — *Southern limit?*

243. AHNFELTIA GIGARTINOIDES, Ag. West coast.

244. AHNFELTIA? PINNULATA, Harv. Key West.

245. CYSTOCLONIUM PURPURASCENS, Kütz. New York northward. — *Southern limit?*

246. CALLOPHYLLIS LACINIATA, Kütz. Cape Henlopen; California, fide *Harvey*.

*247. CALLOPHYLLIS VARIEGATA, Ag. California; west coast of South America; Australia.

*248. CALLOPHYLLIS OBTUSIFOLIA, Ag. (non Harvey, Phy. Austr. vol. 4, pl. 193). — With regard to the Californian species of *Callophyllis* there has been great confusion. This has arisen, in part, from the fact that the only species mentioned in the Nereis Am.-Bor. as found on that coast is *C. laciniata*, which, I am convinced, is rare, if it occurs at all there. I had myself named specimens *C. laciniata*, but, never having received the fruit characteristic of this species from California, my determination was based altogether on the shape of the frond, which, in the specimens I have seen, is never so flabellately expanded as in European specimens of *C. laciniata*, of which I have a large suite. My specimens were all *C. variegata*, which seems to be quite common in California. In this species, the frond is decompound pinnate, the terminal pinnules erect and crenulate. The conceptacles are not in marginal leaflets, as in *C. laciniata*, but in the frond close to, or on, the margin, and of large size. The color is very variable, from rosy red to almost black. The tips are often greenish, as figured in Bory. Coq. pl. 14.

I venture to give the name of *C. obtusifolia*, Ag., to specimens sent me by *Mr. D. Cleveland*, from San Diego, Cal. My reasons for so doing will be more properly stated in another paper. In brief, this species may be known by its narrow, repeatedly dichotomous frond, and conceptacles scattered over the surface prominent on both sides.

Besides the above-mentioned species, I have a specimen, presented by my friend *Prof. D. C. Eaton*, in which the conceptacles are scattered through the frond, which is palmately divided, and of a purplish lake color. This, although agreeing tolerably well with the description, does not resemble very closely the plate of *Callophyllis* (*Rhodymenia*) *ornata*, Mont., of which I have no authentic specimen for comparison. Should this prove new, it ought properly to bear the name of Prof. Eaton.

Callophyllis discigera, Ag., of the Cape of Good Hope, is to be expected in California.

249. CONSTANTINEA SITCHENSIS, Post. and Rupr.

*250. KALLYMENIA PHYLLOPHORA, Ag., Bidrag. Vancouver's Island.

*251. GIGARTINA ACICULARIS, Lmx. Florida, *Dr. E. Palmer.*

252. GIGARTINA CANALICULATA, Harv. West coast.

253. GIGARTINA MOLLIS, Bail. and Harv. Puget Sound.

254. GIGARTINA MAMILLOSA, Ag. Boston northward; Oregon.

255. GIGARTINA MICROPHYLLA, Harv. California. β. var. *horrida.* — A very variable species. Harvey seems to have had only large and tetrasporic specimens. The more common form is what I have called var. *horrida*, which may perhaps prove to be a good species. Here, the frond is not more than half an inch wide, at times almost cylindrical, forking at the tip, and usually with a few pinnæ towards the base. Both the main frond and pinnæ are intricately covered with spines, which are sometimes half an inch long and nearly cylindrical. In these are immersed the conceptacles and the sori of tetraspores, the latter of which are either circular or linear. In those cases where the pinnæ are not so densely covered with spines as usual, the sori are thickly scattered over the surface of the pinnæ themselves.

*256. GIGARTINA JARDINI, Ag., Bidrag. California.

*257. GIGARTINA PISTILLATA, Lmx. San Diego, Cal., *Hassler Exp.;* Europe; Chili.

*258. GIGARTINA VOLANS, Ag. West coast? Vid. Ag., Icon. Ined., table xviii.

259. GIGARTINA SPINOSA, Kütz. California.

260. GIGARTINA EXASPERATA, Bail. and Harvey. Puget Sound. — Seems to me a variety of the next.

261. GIGARTINA RADULA, Ag. West coast. — *Northern limit?*

*262. GIGARTINA CHAMISSOI, Mont.? California, *Harvey.*

263. IRIDÆA MINOR, Ag. California.

264. IRIDÆA DICHOTOMA, Harv. California.

265. IRIDÆA LAMINARIOIDES, Bory. Oregon, *Mr. E. Hall.*

266. IRIDÆA PUNICEA, Post. and Rupr.? Santa Cruz, Cal.

*267. SCHIZYMENIA EDULIS, Ag. Oregon, *Mr. E. Hall.* — Another case of a common European alga, found in Japan and California, but not on the east coast of North America.

268. CHONDRUS CRISPUS, Lyngb. North Carolina, fide *Rev. M. A. Curtis;* and northward. — *Southern limit?*

269. CHONDRUS AFFINIS, Harv. California. — About this plant

there is, and probably always will be, some doubt, as Harvey's specimens were very poor, and, at the best, species of *Chondrus* are very variable. Furthermore, when we consider that sterile specimens of *Gigartina*, *Chondrus*, and *Iridæa*, cannot be generically distinguished from one another by any definite character, and when we remember that species have been described in all these genera from sterile specimens, the prospect is almost hopeless. The variability of *Chondrus crispus* of our eastern coast is well known, and there is no reason why any other *Chondrus* should not vary to the same extent. The question for the California botanists to answer is, Is there more than one species of *Chondrus* on the west coast? If there is but one, it will probably be found that *C. affinis*, Harv., is nothing but a form of *C. canaliculatus*, Ag., which is common on the west coast of South America, and very variable.

270. Endocladia muricata, Ag. San Diego, Cal., northward.

271. Gloiopeltis furcata, Ag. Oregon, *Mr. E. Hall.*

272. Cryptonemia crenulata, Ag. Key West.

*273. Cryptonemia luxurians, Ag. Key West, *Dr. E. Palmer*; West Indies, Brazil, Ceylon.

274. Chylocladia? Baileyana, Harv. Long Island Sound and southward. Said by Zanardini in Phyc. Alg. Adriat, vol. ii. pl. 43, to be the same as *C. uncinata*, Menegh. I have found our plant in fruit, however, and it is not a *Chylocladia* in the proper sense.

275. Chylocladia rosea, Harv. Newport, R.I., *Mr. S. T. Olney*; dredged in ten fathoms off Gay Head, *W. G. F.*; Portsmouth, N.H., *Dr. Durkee.*

276. Chrysymenia enteromorpha, Harv. Key West.

277. Chrysymenia halymenioides, Harv. Key West.

278. Chrysymenia Agardhii, Harv. Key West.

279. Chrysymenia ramosissima, Harv. (*Rhabdonia ramosissima*, Ag., Bidrag, p. 38.) Key West.

280. Chrysymenia? acanthoclada, Harv. Key West.

281. Chrysymenia uvaria, Ag. Key West.

282. Halymenia ligulata, Ag. Key West.

283. Halymenia Floresia, Ag. Key West.

284. Halosaccion hydrophora, Ag. Oregon, *Mr. E. Hall.*

285. Halosaccion fucicola, Post. and Rupr. California.

286. Halosaccion ramentaceum, Ag. Rye Beach, N.H., northward. — *Southern limit?*

287. Furcellaria fastigiata, Lyngh. Said to have been found on the New England coast.

288. Corynomorpha clavata, Ag., Bidray. (*Acrotylus clavatus*, Harv.) Key West.

289. Prionitis lanceolata, Harv. West coast.

*290. Prionitis Andersonii, Eaton. Santa Cruz, San Diego, Cal. — I have specimens from Oregon collected by *Mr. E. Hall*, which resemble the plate of *Fucus crinitus* (Turn. pl. 123). To this plate Ruprecht refers in describing his *Tichocarpus crinitis*, a species recognized by Agardh in his Bidrag till Florideernes Systematik, page 15, and supposed by him to be related to *Pikea* and to be placed in the *Dumontiæ*. *Tichocarpus* bears a strong external resemblance to *Prionitis*, and it is to be hoped that collectors on the west coast will find fruiting specimens of the plant collected by Mr. Hall, that its true position may be determined.

291. Grateloupia Gibbesii, Harv. Charleston, S.C., and southward. — *Grateloupia Cutleriæ* of Chili, which resembles this, is to be expected in California.

292. Grateloupia versicolor, Ag. California?

293. Grateloupia filicina, Ag. Florida.

294. Catanella pinnata, Harv. Key West.

*295. Nemastoma? Bairdii, n. sp. Frons vermiformis, gelatinosa, dichotoma; axillæ acutæ, segmenta terminalia attenuata. Sporas non vidi. Tetrasporæ cruciatæ solitariæ ad geniculas ramellorum corticalorum. — Gay Head, Mass.

Of this rare plant there is but one specimen known. This was found by me washed ashore at Gay Head, and supposed, at the time, to be a *Nemalion*. The genus *Nemalion*, however, has tripartite tetraspores, and our plant more properly belongs to *Nemastoma*, the nearest allied species of which is *N. vermicularis*. From this it differs by being dichotomous.

296. Gloiosiphonia capillaris, Carm. Occasionally from Long Island Sound to Cape Ann, Mass.

SPYRIDIACEÆ.

297. Spyridia aculeata, Kütz. Florida.

298. Spyridia filamentosa, Harv. Massachusetts Bay southward.

CERAMIACEÆ.

299. Microcladia Coulteri, Harv. West coast, common.

*300. Microcladia Californica, n. sp. Frons compressa, decomposita pinnata. Pinnulæ ultimæ dichotomo-corymbosæ. Favellæ

ad ramellos externe insertæ, nudæ. Forma et substantia *P. Coulteri* similis, ramificatione ultimarum pinnularum et insertione favellarum differt. — California, Oregon.

It has long seemed to me that the specimens of *Microcladia Coulteri* distributed by collectors differed very much in aspect, and that at least two different varieties could be distinguished. *M. Californica*, in fruit, is easily distinguished from the typical specimens and figure of *M. Coulteri* by the favellæ which are borne on the outer side of the ultimate ramuli, and are always destitute of the involucre which is found in *M. Coulteri*. *M. Californica* resembles in habit *Polysiphonia Woodii*, which *M. Coulteri* does not.

301. Microcladia borealis, Rupr. California, Oregon.

302. Centroceras clavulatum, Ag. Key West, California.

*303. Centroceras Eatonianum, n. sp. Frons capillaris, inermis, pinnata. Pinnæ distichæ, bi-tripinnatæ, segmenta terminalia divaricata. Geniculæ constrictæ. — Oregon, *Mr. E. Hall;* California.

This species bears more resemblance to a *Ceramium* than to *C. clavulatum*, from which it differs in being pinnate instead of dichotomous and constricted at the joints, which are smooth and destitute of spines.

304. Ceramium nitens, Ag. Key West.

305. Ceramium rubrum, Ag. Everywhere on the east coast, but not yet known, with certainty, on the west.

306. Ceramium Deslongchampsii, Ch. Common on rocks. Nahant, Mass., northward.

The species called by Harvey *Ceramium Hooperi* was founded on poor specimens of *C. Deslongchampsii*, a common European species. Harvey mentions the "dark purple endochrome" as peculiar to *C. Hooperi*. It is, however, found in *C. Deslongchampsii*. The "root-like filaments" are found in all the procumbent *Ceramia* and *Polysiphoniæ*. Harvey says that the plant is one or two inches high. I have collected it in Portland harbor nearly five inches high.

307. Ceramium diaphanum, Roth. Certainly not common on the east coast, although I have found what I think must be this species at Nahant, Mass. — Key West and California specimens look more like the typical European specimens than do the New England specimens.

*308. Ceramium strictum, Harv. New Haven, Noank, Conn.; Wood's Hole, Mass. — Nine-tenths of the American specimens of *C. diaphanum* belong to this species, which is much more slender and somewhat corymbose.

309. Ceramium tenuissimum, Lyngb. Key West, *Harvey*.

310. Ceramium fastigiatum, Harv. Long Island Sound, Massa-

chusetts Bay. — The *Ceramium arachnoideum?* Ag. of the Nereis Am.-Bor. is not the true species of Agardh, to whom I showed American specimens. The species so designated by Harvey is not uncommon on the New England coast; but what it really is, whether peculiar to America or a European species also, must remain in doubt.

311. Ceramium byssoideum, Harv. Key West.

312. Ptilota densa, Ag. California.

313. Ptilota hypnoides, Harv. (inc. *P. Californica*, Rupr. partim). — This species was first described in 1841 by Harvey in the botany of Beechey's Voyage. In the Nereis Am.-Bor., Harvey also describes a *Ptilota Californica*, Rupr., with a variety *concinna.* Through the kindness of Prof. Wright, of Dublin, I was enabled to examine the specimens of the last-named species and variety in the Harvey Herbarium.

Strange to say, the *P. Californica* of Harvey's Herbarium corresponds precisely to the description and plate of *P. hypnoides*, while the variety *concinna* is quite different and more closely related to *P. plumosa.* Furthermore, the var. *concinna* is not the *P. concinna* of the Rodgers and Ringgold Expedition. There can be little doubt that *P. hypnoides* and *P. Californica*, exclusive of var. *concinna*, should be united. The question is, Which name has the priority? There is no reference to *P. Californica* either in Postels and Ruprecht's Illustrationes or in the Phycologia Ochotensis, and I cannot ascertain when or where it was ever published by Ruprecht. On the supposition that it was first described by Harvey in the Nereis Am.-Bor., the name *P. Californica* should give place to *P. hypnoides* of Beechey's Voyage.

The position of the var. *concinna* is difficult to define. I saw in the Ruprecht Herbarium at St. Petersburg specimens labelled *P. filicina*, which were evidently the same as the var. *concinna.* If I am not mistaken, *P filicina* was never published by Ruprecht. After a careful comparison of Californian specimens with authentic specimens of *P. plumosa* presented by Prof. Agardh, I venture to express the opinion that *P. Californica*, var. *concinna*, of the Nereis Am.-Bor., is a variety of *P. plumosa;* and, not to confuse it with the specimens of Rodgers and Ringgold's Expedition, distributed under the name of *P. concinna*, I would propose the name *P. plumosa*, var. *filicina.* This variety differs from the type in being more regularly pinnate and of a thicker substance. Fragments of the base look like a distinct species; but examination of the tips and younger undenuded parts of the frond show that they are not specifically distinct from *P. plumosa.* The specimens distributed with Hall's Oregon Algæ as *P. pectinata*, Harv.,

belong to the variety under consideration. I had named them *P. pectinata*, Harv. (*P. densa*, Ag.), after comparing them with a specimen from Lenormand, which I have since found out is incorrectly named.

The species of *Ptilota* of our west coast may be briefly enumerated as follows: —

P. densa, Ag., in which the pinnæ are *falcate* and incised on the *outer* side only, as is well shown in Pl. XXXII. B. fig. 2, of Nereis Am.-Bor. This species seems more common southward.

P. hypnoides, Harv. More delicate than the last, with pinnæ, which are *lanceolate*, with a smooth, slightly crenulated, or dentate margin, and *contracted at the base*. Pl. XXXII. A. B. C.

P. aspenioides, Ag., differing from the last by being coarser and having the usually somewhat serrated pinnæ *decurrent at the base*. This occurs in Oregon, and is a common species of Alaska.

P. plumosa, Ag. More common northward, and var. *filicina* found also in California. In this species the pinnæ are regularly *pectinate on both sides*.

314. Ptilota asplenioides, Ag. Oregon northward.

315. Ptilota plumosa, Ag., and var. filicina. California northward; east coast, very rare?

316. Ptilota serrata, Kütz. Nahant, Mass., northward, common; Sitcha.

317. Ptilota elegans, Bonnem. New York northward. Not so common north of Cape Cod as in Long Island Sound.

318. Crouania attenuata, J. Ag. Key West.

319. Halurus equisetifolius, Kütz.

320. Griffithsia corallina? Ag. and var. *tenuis*. — Under this, in the Nereis Am.-Bor., are included two different species, neither of which is certainly *C. corallina*. The variety *tenuis* was afterwards considered by Harvey a *Callithamnion*. This variety occurs as far north as Gloucester, Mass. In the absence of fruit, it is impossible to say whether it is a *Callithamnion* or not.

321. Callithamnion Pikeanum, Harv. California.

322. Callithamnion tetragonum, Ag. New York northward.

323. Callithamnion Baileyi, Harv. New York northward.

324. Callithamnion squarrulosum, Harv. California. — The specimens distributed under this name in Hall's Oregon Algæ now seem to me doubtful.

325. Callithamnion Borreri, Ag. New York to New Bedford.

326. Callithamnion polyspermum, Ag. New York southward.

327. Callithamnion byssoideum, Arn. New York to Nahant, Mass.

328. Callithamnion Dietziæ, Hooper. — Among the algæ collected by me at Wood's Hole were several *Callithamnia*, which I was unable to determine. Some of the specimens which I thought might be *C. Dietziæ* proved to be varieties of *C. byssoideum*. Three specimens, on comparison with the type in the Herbarium of Trinity College, Dublin, prove to be *C. Dietziæ*, which is apparently rare.

329. Callithamnion corymbosum, Ag. New York northward.

330. Callithamnion versicolor, Ag., var. seirospermum, Harv. New York northward. — This is not the only species in which the so-called seirospores are found, as they are also recorded by Zanardini in *C. graniferum*, Menegh.

331. Callithamnion plumula, Lyngb. Long Branch, N.J.; Newport, R.I.; Gay Head, Mass., &c. — The var. *crispum*, which is common in some parts of Europe, does not occur in America.

332. Callithamnion Americanum, Harv. New York northward.

333. Callithamnion Pylaisæi, Mont. (*Wrangelia*, Ag.) Nahant northward. — *Fruit?*

334. Callithamnion floccosum, Ag. Boston, Cape Ann, Mass.; Portland, Me.

335. Callithamnion cruciatum, Ag. New York and various places in Long Island Sound.

336. Callithamnion Turneri, Ag. (*Spermothamnion*, Aresch.) In several places on Long Island Sound; Nantucket, very abundant, *W. G. F.*

337. Callithamnion Rothii, Lyngb. (*Thamnidium*, Thuret.) In several places on the New England coast, growing on rocks. — The remaining species of *Callithamnion* of the Nereis Am.-Bor. are properly *Chantransiæ* and should be removed from *Ceramiaceæ*.

*338. Chantransia secundata, Thur. on *Chætomorpha tortuosa*. Peak's Island, Me.

339. Chantransia virgatula, Thur. New York; Cape Ann, Mass.

340. Chantransia Daviesii, Thur. Gloucester, Mass., *Mrs. J. T. Lusk*.

INCERTÆ SEDIS.

341. Pikea Californica, Harv. California.

*342. Pikea Woodii, Ag., Bidrag. Vancouver's Island.

*343. Pikea Grayana, Ag, Bidrag. Vancouver's Island. — The genus *Pikea* was founded by Harvey, who described *P. Californica* from sterile specimens which had been sent to him. In his Bidrag

till Florideernes Systematik, published in 1870, Agardh, who at that time had never seen a specimen of *P. Californica*, added two more species and first described the fruit, from which he decided that the genus belonged to the *Dumontiæ*. I have no specimens of *P. Woodii* or *P. Grayana*. Of *P. Californica* I have only seen fruiting specimens through the kindness of Prof. Eaton. As the plant should be examined in a living condition, I will not increase our ignorance by saying any thing on the subject. It is evidently destined to wander through different orders before reaching its final resting-place.

CHLOROSPERMÆ.

SIPHONACEÆ.

344. Caulerpa prolifera, Lmx. Florida.

345. Caulerpa crassifolia, Ag., var. Mexicana. (*C. Mexicana*, Sond.) Florida.

346. Caulerpa plumaris, Ag. Florida.

347. Caulerpa Ashmeadii, Harv. Key West.

348. Caulerpa ericifolia, Ag. Florida.

349. Caulerpa cupressoides, Ag. Key West.

350. Caulerpa lanuginosa, Ag. (*C. Lycopodium*, Harv.) Key West.

351. Caulerpa Paspaloides, Bory. Florida.

352. Caulerpa clavifera, Ag. Florida. — The fructification of this interesting genus has not yet been observed. As Key West offers better material than the shores of Europe, it is to be hoped that some of our countrymen will turn their attention to this point.

353. Halimeda Opuntia, Lmx. Florida.

354. Halimeda incrassata, Lmx. Florida.

355. Halimeda tridens, Lmx. Key West.

356. Halimeda tuna, Lmx. Florida.

357. Udotea flabellata, Lmx. Key West.

358. Udotea conglutinata, Lmx. Key West.

359. Codium tomentosum, Stack. Florida; west coast.

360. Chlorodesmis? Vaucheriæformis, Harv. Key West.

361. Bryopsis plumosa, Lmx. Whole eastern coast.

362. Bryopsis hypnoides, Lmx. Key West.

DASYCLADEÆ.

363. Dasycladus occidentalis, Harv. Florida.

*364. Dasycladus clavæformis, Ag. Key West, West Indies; Mediterranean.

365. ACETABULARIA CRENULATA, Lmx. Florida. — For the history of the development of this genus we are indebted to Woronin, whose researches, however, were brought to an end before he had seen the dispersion and germination of the spores. *Dr. E. Palmer*, while at Key West last summer, collected specimens of this plant in fruit, and in some of them the radiating cells at the summit had separated, giving the appearance seen in the genus *Polyphysa.* It might be asked whether *P. Cliftoni*, Harv., which is figured in fruit in the Phycologia Australica and described as rare, is any thing more than the fruiting state of some *Acetabularia.*

VALONIACEÆ.

366. CHAMÆDORIS ANNULATA, Mont. Key West.

367. PENICILLUS DUMETOSUS, Dne. Florida.

368. PENICILLUS CAPITATUS, Lmk. Key West.

369. PENICILLUS PHŒNIX, Lmk. Florida.

370. BLODGETTIA CONFERVOIDES, Harv. — This plant is certainly worthy a most careful study. The figure of Harvey is most extraordinary; and, if correct, this plant deserves, at least, to be the type of a new order. As M. Bornet suggests, however, the spores? are parasitic unicellular algæ. The *Blodgettia* itself is probably nothing more than a *Cladophora* nearly related to *C. prolifera.*

371. ANADYOMENE FLABELLATA, Lmx. Key West.

372. DICTYOSPHÆRIA FAVULOSA, Dne. Key West.

*373. ASCOTHAMNION INTRICATUM, Kütz. Key West, *Dr. E. Palmer.*

ULVACEÆ.

374. PORPHYRA VULGARIS, Ag. East and west coasts.

375. BANGIA FUSCOPURPUREA, Lyngb. East coast.

376. BANGIA VERMICULARIS, Harv. West coast.

377. ERYTHROTRICHIA CILIARIS, Thuret. (*Bangia*, Harv. Ner.) Charleston, S.C.

*378. ERYTHROTRICHIA CERAMICOLA, Aresch. (*Bangia*, Harv. Phyc. Brit. pl. 317.) Cape Ann, Mass.; Portland harbor, Me., *W. G. F.*

*379. GONIOTRICHUM ELEGANS, Zanard. On Dasya. Gloucester, Mass. Coll. by *Mrs. J. T. Lusk.*

380. ENTEROMORPHA INTESTINALIS, Link. Everywhere.

381. ENTEROMORPHA COMPRESSA, Grev. Everywhere. — Both of the last are included by Le Jolis in *Ulva enteromorpha.*

382. ENTEROMORPHA CLATHRATA, Grev. (inc. *E. Hopkirkii*, &c.) Common, east coast.—This and a part of *E. compressa* are included by Le Jolis in *Ulva clathrata*.

383. ULVA FASCIATA, Delile. California.

384. ULVA LINZA, Linn. A variety of the next.

385. ULVA LATISSIMA, Linn. Everywhere.

386. ULVA LACTUCA, Linn. With the last, but not so common.

387. CLADOPHORA REPENS, Ag. Key West.

388. CLADOPHORA MEMBRANACEA, Ag. Key West.

389. CLADOPHORA RUPESTRIS, L. New York northward.

390. CLADOPHORA CARTILAGINEA, Rupr. West coast.

391. CLADOPHORA ARCTA, Dillw. New York northward.

392. CLADOPHORA LANOSA, Roth. Boston?

393. CLADOPHORA UNCIALIS, Fl. Dan. At different points on the New England coast.

394. CLADOPHORA GLAUCESCENS, Griff. Charleston, S.C., northward.

395. CLADOPHORA FLEXUOSA, Griff. New York, Massachusetts Bay.

396. CLADOPHORA MORRISIÆ, Harv. Elsinborough, Del., *Miss Morris*.

397. CLADOPHORA REFRACTA, Roth. Charleston, S.C., northward.

398. CLADOPHORA ALBIDA, Huds. New York and New Jersey.

399. CLADOPHORA RUDOLPHIANA, Ag. Jackson's Ferry, N.Y.

400. CLADOPHORA GRACILIS, Griff. Beesley's Point, N.J.; Rhode Island; Nahant, Mass.

401. CLADOPHORA BRACHYCLADOS, Mont. Texas.

402. CLADOPHORA LUTEOLA, Harv. Key West.

403. CLADOPHORA LÆTEVIRENS, Dillw. New York; Boston; California.

404. CLADOPHORA DIFFUSA, (?) Harv. New York.

405. CLADOPHORA FRACTA, Fl. Dan. New York and New Jersey.

406. CHÆTOMORPHA PIQUOTIANA, Mont. New York northward.

407. CHÆTOMORPHA MELAGONIUM, Weh. and Mohr. Boston northward.

408. CHÆTOMORPHA AEREA, Dillw. Newport, R.I.; New York.

409. CHÆTOMORPHA OLNEYI, Harv. Rhode Island.

410. CHÆTOMORPHA LONGIARTICULATA, Harv. Massachusetts and Rhode Island, *fide Harvey*.

411. CHÆTOMORPHA SUTORIA, Berk. Stonington, Conn.

412. Chætomorpha brachygona, Harv. Key West.

413. Chætomorpha tortuosa, Dillw. Nahant, Mass., northward. Common.

414. Hormotrichum Younganum, Dillw. New York.

415. Hormotrichum Carmichælii, Harv. Boston, *Mr. Calverly*.

416. Lyngbya majuscula, Harv. Wood's Hole, Mass., and southward.

417. Lyngbya ferruginea, Ag. New York; Greenport, L.I.

418. Lyngbya fulva, Harv. Stonington, Conn.

419. Lyngbya nigrescens, Harv. Peconic Bay, L.I.

420. Lyngbya confervoides, Ag. Charleston, S.C.

421. Lyngbya pusilla, Harv. Sullivan's Island, S.C.

422. Lyngbya hyalina, Harv. Key West.

423. Calothrix confervicola. Ag. Everywhere.

424. Calothrix scopulorum, Ag. Everywhere.

425. Calothrix vivipara, Harv. Seaconnet Point, R.I..

426. Calothrix pilosa, Harv. Key West.

427. Calothrix dura, Harv. Key West.

428. Microcoleus corymbosus, Harv. Key West.

*429. Sphærozyga Carmichælii, Harv. Noank, Conn.; Europe.

*430. Rivularia atra, Roth. New England. Common on rocks and shells. Europe.

XII.

BRIEF CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF HARVARD COLLEGE,

UNDER THE DIRECTION OF

JOHN TROWBRIDGE, ASSISTANT-PROFESSOR OF PHYSICS.

No. II.—ON A NEW INDUCTION COIL.

Read, April 13, 1875.

IN the best constructed induction coils of the present day, the electro-magnet is prolonged beyond the induction coil; so that the latter occupies the middle of the electro-magnetic core, where the inductive effect is the greatest. The core of the electro-magnet consists of a bundle of iron wires, which, by their want of continuity of mass, break up the currents of induction which form in the mass of a large solid core, and prevent the sudden breaking of the electro-magnetic circuit, which is so desirable, in order to produce great effects of tension.

The preceding experiments, made with armatures to electro-magnets, which I suggested to Mr. Lefavour and Mr. Peirce, led me to think that the effect of an induction coil could be increased by providing its core with an armature. I first experimented with a horseshoe-shaped solid core, 2.5 cm. in diameter; the limbs of which were 12 cm. long, and the distance between the limbs was also 12 cm. On one of the limbs was slipped a coil of thick copper wire, of .07 of an ohm resistance. The induction coil, which was of copper wire, one ohm in resistance, was distributed uniformly over the primary coil. The induction coil was connected with a Thomson's reflecting galvanometer. The following table shows the results which were obtained when the circuit was broken in the primary coil. The deflections at making the circuit are not given, since they were equal to those produced by breaking the circuit; and the study of the induction currents produced by breaking are the most important for our present purpose. The induction currents were first obtained without the use of an armature upon the two limbs of the electro-magnet, and then with the armature in position.

TABLE I.

Deflection without Armature.	Deflection with Armature.
60	130
61	130
60	120
62	130
60	135

This table shows that the strength of the induced currents was increased one hundred per cent by the application of the armature. In the above experiments the armature rested upon the limbs of the electro-magnet directly at the poles of the electro-magnet; and the ends of the limbs of the horseshoe-shaped core were filed plane, so that the armature rested completely upon them. The armature should have a length equal to the distance between the poles of the electro-magnet.

The above experiments were then repeated with cores made of small iron wire, tied in bundles, which were horseshoe in form, in order to determine whether a core of this nature differed from a solid one. The preceding results were sustained. Some difficulty was met in filing the ends of the bundle of iron wires, so that the armature should rest completely upon them, but this was a mechanical difficulty only. I next proceeded to experiment on a larger scale. The primary circuit was wound upon one limb of a horseshoe-shaped core, the limbs of which were 26 cm. long, 4 cm. in diameter, and the centres of which were 19 cm. apart. The primary coil consisted of four turns of thick copper wire, having a total resistance of .10 of an ohm. This covered one limb of the horseshoe uniformly; the other limb was not covered. The secondary coil had a resistance of 6,000 ohms, and the height of the secondary coil was equal to that of the primary. A condenser was placed in the primary circuit, which was also provided with an interrupter or break-piece. At first I endeavored to ascertain by measuring the length of the spark, produced by breaking the primary circuit, the advantage of placing an armature upon the poles of the electro-magnet. Very contradictory results were obtained; and at first sight it did not appear that any advantage resulted from the use of the armature. I next, having drawn the terminals of the secondary coil apart, so that a spark could just leap across the interval, counted the number of sparks with breaks of the primary circuit one second apart. The following table gives a series of results: —

Without the Armature.		With the Armature.	
At the end of 14 seconds,	8	At the end of 14 seconds,	12
" " "	5	" " "	10
" " "	6	" " "	9
" " "	4	" " "	10
" " "	8	" " "	13
" " "	9	" " "	13
" " "	7	" " "	9
" " "	7	" " "	5
	54		81

This method of observation, however, was far from satisfactory; the passage of the sparks was very capricious, and it often seemed as if the armature was of no advantage; although, if the trials were extended over a sufficiently large interval, a gain was shown in using the armature. I speedily resolved to make use of one of Sir William Thomson's new quadrant electrometers, and to measure the difference of potential of the terminals of the secondary coil directly. The coils were arranged as previously, and by means of a peculiarly constructed key the electrometer terminals were connected with those of the secondary coil. A small grove cell of the Elliott pattern was used. This cell, however, was very much weakened by a shunt. The following tables show the results which were obtained; the deflections are expressed in the divisions of the electrometer scale.

WITHOUT THE ARMATURE.

Deflections produced by making the Primary Circuit.	Deflections produced by breaking the Primary Circuit.
30	85
27	83
31	84
23	80
Mean, 27	Mean, 83

WITH THE ARMATURE.

Deflections produced by making the Primary Circuit.	Deflections produced by breaking the Primary Circuit.
75	83
70	77
74	83
75	83
Mean, 73	Mean, 81

It will be seen by the above tables that the difference of potential is more than doubled by the application of the armature. These experiments were conducted with solid cores, on account of the difficulty, with the means at my immediate command, of making the ends of bundles of iron wire sufficiently plane. Experiments were next made to determine the influence of the size of the armature. The following table shows the results:—

TABLE II.

Weight of Armature.	Deflections.
Grammes.	
480	130
300	131
240	130
100	129
150	130

The mass of the armature, therefore, appeared to make no difference. Experiments speedily showed, however, that the induced currents were affected by the amount of bearing surface of the armature and the disposition of its mass between the two poles of the electro-magnet of the horseshoe on which the primary coil was placed. There is no doubt that the core of the electro-magnet should consist of small iron wires, as in the ordinary Ruhmkorf coil. The iron core, with the armature, would then be in the form of a hollow square, one side of which is made up of a bundle of fine iron wires, and the remaining three equal sides constitute the armature. It appears from the above investigation that we can reduce the expense of the present form of induction coil, for a much less number of winding of fine wire will be needed when an armature is employed, to produce the same strength of induced currents that are produced in straight electro-magnets without armatures.

No. III.— ON THE EFFECT OF ARMATURES ON THE MAGNETIC STATE OF ELECTRO-MAGNETS.

By B. O. Peirce and E. B. Lefavour.

M. Jamin has lately shown that the effect in providing a steel magnet with an armature consists merely in a redistribution of magnetism, but not in an increase. The following experiments were instituted, to determine what was the effect of armatures of electro-magnets on their magnetic state. The method of experimenting was to slip a coil of fine wire over the electro-magnet, which was provided with a scale, and to measure by the swing of the needle of a reflecting galvanometer the induction currents which arise on making and breaking the circuit of the electro-magnet. The first experiments were made with a straight electro-magnet, 19 cm. long, 1.5 cm. wide. The core consisted of a bundle of fine iron wires, the ends of which were filed in one plane, upon which the armature, which consisted of a piece of iron 6 cm. long, 1.5 cm. wide, rested. It was found that the mass of this armature made no difference, as long as the end of the core of the electro-magnet was completely covered, and in close contact with the armature. The following table gives the results obtained. Only the currents produced by breaking the primary circuit are given.

TABLE I.

Distance along the Electro-Magnet.	Deflections without Armature.	Deflections with Armature.
1	100	130
2	118	132
3	126	140
4	135	148
5	142	166
6	150	176
7	157	178
8	156	178
9	157	160
10	157	160
11	158	173
12	148	176
13	140	171
14	125	166
15	112	156
16	100	145

When these results are represented by curves, they show that the magnetic state, in a straight electro-magnet without an armature,

increases from both ends towards the middle (which was shown to be the case by Jacobi and Lenz in 1844); and when the armature is applied, the curves diverge greatly near the pole upon which the armature is placed.

Our next experiments were tried with a solid horseshoe-shaped electro-magnet, the limbs of which were 12 cm. long, 2.5 cm. in diameter; the resistance of the electro-magnet was about .01 of an ohm and that of the induction coil 1 ohm.

TABLE II.

Distance on limb of Magnet.	Deflections without Armature.	Deflections with Armature.
1	102	211
2	103	220
3	105	220
4	105	228
5	105	228
6	103	225
7	96	224
8	89	222
9	81	220
10	75	219
11	65	213
12	51	207

The scale runs, increasing, from the bend of the electro-magnet to the pole of the limb on which the induction coil was slipped. Here there is a marked increase, resulting from the use of the armature, which is shown in a striking manner by expressing the above results as curves. The results of our experiments show: —

1st. The application of an armature to one pole of a straight electro-magnet results in an increase of the magnetic condition of the magnet.

2d. The application of an armature to both poles of a horseshoe-shaped magnet results in a remarkable increase of its magnetic state, which increase is much the greatest near the armature.

No. IV.—ON THE TIME OF DEMAGNETIZATION OF SOFT IRON.

By W. C. Hodgkins and J. H. Jennings.

The following experiments were undertaken to determine the length of time that the core of an electro-magnet remained magnetic after the cessation of the magnetizing current. A chronograph, provided with two pens, was used to measure the intervals of time. The method adopted to obtain these results on paper was as follows: The lower pen of the chronograph, which was movable by a lever, worked by hand, was connected with the electro-magnet and with the battery which served to excite the electro-magnet. By pressing the lever down, the circuit of the electro-magnet was broken, and at the same instant the lower pen was moved upwards. The upper pen formed the armature of a small electro-magnet, and moved downward upon the passage of a current through the coils of this magnet. One end of the wire of this small electro-magnet was connected with the positive pole of a Bunsen cell, the negative pole of which was joined to a brass plate, which was placed immediately beneath the large electro-magnet which was to be tested. The second wire from the small electro-magnet, which worked the upper pen of the chronograph, was connected with a small piece of soft iron which formed the armature of the large electro-magnet.

It will be seen that when no current was passing through the large electro-magnet, its armature would rest upon the brass plate immediately beneath it, and the circuit of the upper pen of the chronograph would be completed. On the other hand, upon the passage of a current, the armature would be raised, thus breaking the circuit of the upper pen.

The method adopted was to pass the current through the coil of the large electro-magnet, start the chronograph, and then, by means of the lever on the lower pen, repeatedly break and make the circuit; thus making and breaking the circuit of the upper pen, and moving both pens at intervals, which represented the required time of demagnetization. The interval required to demagnetize the small electro-magnet, in the circuit of the upper pen, did not enter into the results, since this pen was used merely to denote the instant when its circuit was made. The time of demagnetization was determined in this manner, with a coil 220 mm. in diameter, and with cores successively 54 mm., 41 mm., and 29 mm. in diameter. The battery power varied from four cells

to ten cells of grove. The armature was a piece of soft iron, weighing 22 grammes. The thickness of the coil, which was equal to the lengths of the iron cores, was 65 mm. The wire of which it was composed was 3 mm. in diameter.

The results of these experiments are given in the following table:—

No. of Cells.	Diameter of Core.	Interval in seconds.	No. of Measurements.
4	53.5 mm.	.091	116
4	41.0	.090	174
4	29.0	.085	148
10	53.5	.107	147
10	41.0	.088	207
10	29.0	.084	170

Experiments were then made with horseshoe electro-magnets; but it was speedily found that the phenomenon of the adherence of the armature, after the breaking of the galvanic circuit entered, and the time of release of the armature, was practically infinite. With straight electro-magnets, the above experiments show that the magnetic strength sufficient to maintain an armature of constant weight at the respective poles, had a duration of .091 of a second, and appeared to be not sensibly affected by increase or diminution of the magnetic state of the core, beyond that requisite to barely sustain the weight of the armature.

Table II. gives the percentage of light transmitted by 1, 4, and 10 plates for different values of i. The first column gives the values of i; the second, fourth, and sixth columns give the observed amounts of light transmitted; and the third, fifth, and seventh columns give the theoretical amounts. These last were calculated from the formula $t = \frac{1}{2}\left(\frac{1-A}{1+(m-1)A} + \frac{1-B}{1+(m-1)B}\right)$, in which A was determined from the equation $A = \frac{\sin^2(i-r)}{\sin^2(i+r)}$, and B from the equation $B = \frac{\tang^2(i-r)}{\tang^2(i+r)}$, by substituting the proper values for the angles of incidence and refraction, assuming the index of refraction to be 1.55. Constructing the points, with abscissas equal to the angles of incidence and ordinates to the observed amounts of light transmitted, it will be found that they form very smooth curves. But it will be noticed that while they agree in general with the theoretical results, assuming that the light is lost by simple specular reflection, the differences are considerable, showing that we ought not in our calculation to neglect the opacity of the glass, imperfection of the surface, and other sources of error.

From the numbers in this table, we conclude that, while the amount of light transmitted by one plate decreases considerably as i increases, the amount transmitted by four plates is more nearly constant for small angles, and the amount transmitted by ten plates actually increases until i becomes 55°; which facts agree with the conclusions arrived at theoretically by Prof. Pickering. (Proc. Amer. Acad. Vol. IX. p. 6.)

It was impossible to carry these experiments beyond $i = 65°$ with the apparatus employed, because the disc came so near the mirror as to cast a shadow upon itself.

Plates

0
1
2
3
4

[illegible] ANALYSIS TO [illegible]

[illegible] of the product to the [illegible] which is related to A [illegible] conception of these alge- [illegible] "absolute" algebra, as [illegible] can only be products [illegible] general expression of the [illegible] — etc. Multiply this by [illegible] the product by

second [illegible] the am[illegible] in wh[illegible] ber o[illegible] tion [illegible] num[illegible] betw[illegible]

[illegible]) I

[illegible] J.

[illegible] relative algebra, so that

[illegible] etc.

[illegible] etc.

[illegible] either of them into any [illegible] some letter of that algebra. [illegible] this supposition seems

[illegible] is resolved into a sum [illegible] and $A:B$ such that

[illegible] with ease, but in some [illegible] I have not found the pro- [illegible] actually resolved all the [illegible] the Quintuple ones, [illegible] a few examples.

$bi_5.$

	i	j	k	l	m
i	j	0	l	0	0
j	0	0	0	0	0
k	$j+al$	0	0	0	$bj+cl$
l	0	0	0	0	0
m	$a'j+b'l$	0	$c'j+d'l$	0	l

$$i = cd'\,A:B + b'\,B:C + b'\,D:E.$$
$$j = b'cd'\,A:C.$$
$$k = cd'\,A:B + acd'\,D:B + b'c^2d'\,D:F + cd'\,E:C + bb'cd'\,A:F.$$
$$l = b'cd'\,D:C.$$
$$m = a'cd'\,A:B + b'c'\,A:E + b'cd'\,D:B + b'd'\,D:E + b'cd'\,D:F + F:C.$$

$bd_5.$

	i	j	k	l	m
i	j	0	l	0	0
j	0	0	0	0	0
k	$j+rl$	0	$i+m$	0	$-j-rl$
l	0	0	j	0	0
m	$(r^2-1)j$	0	$-l$	0	$-r^2j$

$$i = A:D + D:F + B:E + C:F.$$
$$j = A:F.$$
$$k = rA:B + rB:C + D:E - \tfrac{1}{r}D:F + E:F.$$
$$l = A:E - \tfrac{1}{r}A:F + B:F.$$
$$m = r^2A:C - A:D - B:E - C:F.$$

ON THE APP

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XV.

ON THE USES AND TRANSFORMATIONS OF LINEAR ALGEBRA.

BY BENJAMIN PEIRCE.

Presented, May 11, 1875.

SOME definite interpretation of a linear algebra would, at first sight, appear indispensable to its successful application. Whereas it is a singular fact, and one quite consonant with the principles of sound logic, that its first and general use is mostly to be expected from its want of significance. The interpretation is a trammel to the use. Symbols are essential to comprehensive argument. The familiar proposition that all A is B, and all B is C, and therefore all A is C, is contracted in its domain by the substitution of significant words for the symbolic letters. The A, B, and C, are subject to no limitation for the purposes and validity of the proposition; they may represent not merely the actual, but also the ideal, the impossible as well as the possible. In Algebra, likewise, the letters are symbols which, passed through a machinery of argument in accordance with given laws, are developed into symbolic results under the name of formulas. When the formulas admit of intelligible interpretation, they are accessions to knowledge; but independently of their interpretation they are invaluable as symbolical expressions of thought. But the most noted instance is the symbol, called the impossible or imaginary, known also as the square root of minus one, and which, from a shadow of meaning attached to it, may be more definitely distinguished as the symbol of *semi-inversion*. This symbol is restricted to a precise signification as the representative of perpendicularity in quaternions, and this wonderful algebra of space is intimately dependent upon the special use of the symbol for its symmetry, elegance, and power. The immortal author of quaternions has shown that there are other significations which may attach to the symbol in other cases. But the strongest use of the symbol is to be found in its magical power of doubling the actual

universe, and placing by its side an ideal universe, its exact counterpart, with which it can be compared and contrasted, and, by means of curiously connecting fibres, form with it an organic whole, from which modern analysis has developed her surpassing geometry. The letters or units of the linear algebras, or to use the better term proposed by Mr. Charles S. Peirce, the *vids* of these algebras, are fitted to perform a similar function each in its peculiar way. This is their primitive and perhaps will always be their principal use. It does not exclude the possibility of some special modes of interpretation, but, on the contrary, a higher philosophy, which believes in the capacity of the material universe for all expressions of human thought, will find, in the utility of the vids, an indication of their probable reality of interpretation. Doctor Hermann Hankel's alternate numbers, with Professor Clifford's applications to determinants, are a curious and interesting example of the possible advantage to be obtained from the new algebras. Doctor Spottiswoode in his fine, generous, and complete analysis of my own treatise before the London Mathematical Society in November of 1872, has regarded these numbers as quite different from the algebras discussed in my treatise, because they are neither linear nor limited. But there is no difficulty in reducing them to a linear form, and, indeed, my algebra (e_3) is the simplest case of Hankel's alternate numbers, and in any other case in which n is the number of the Hankel elements employed, the complete number of vids of the corresponding linear algebra is 2^n-1. The limited character of the algebras which I have investigated may be regarded as an accident of the mode of discussion. There is, however, a large number of unlimited algebras suggested by the investigations, and Hankel's numbers themselves would have been a natural generalization from the proposition of § 65 of my algebra.* Another class of unlimited algebras, which would readily occur from the inspection of those which are given, is that in which all the powers of a vid are adopted as independent vids, and the highest power may either be zero, or unity, or the vid itself, and the zero power of the fundamental vid, *i. e.*, unity itself may also be retained as a vid. But I desire to draw especial attention to that class, which is also unlimited, and for which, when it was laid before the mathematical society of London in January of 1870, Professor Clifford proposed the appropriate name of *quadrates*.

* This remark is not intended as a foundation for a claim upon the Hankel numbers, which were published in 1867, three years prior to the publication of my own treatise. — B. P.

QUADRATES.

The best definition of quadrates is that proposed by Mr. Charles S. Peirce. If the letters A, B, C, &c., represent absolute quantities, differing in quality, the vids may represent the relations of these quantities, and may be written in the form

$(A:A)\ (A:B)\ (A:C)\ \ldots\ (B:A)\ (B:B)\ \ldots\ (C:A)$, &c.

subject to the equations

$$(A:B)\ (B:C) = (A:C)$$
$$(A:B)\ (C:D) = 0.$$

i. e. every product vanishes, in which the second letter of the multiplier differs from the first letter of the multiplicand, and, when these two letters are identical, both are omitted, and the product is the vid which is compounded of the remaining letters which retain their relative position.

Mr. Peirce has shown by a simple logical argument that the quadrate is the legitimate form of a complete linear algebra, and that all the forms of the algebras given by me must be imperfect quadrates, and has confirmed this conclusion by actual investigation and reduction. His investigations do not however dispense with the analysis, by which the independent forms have been deduced in my treatise, but they seem to throw much light upon their probable use.

UNITY.

The sum of the vids $(A:A)$, $(B:B)$, $(C:C)$, &c., extended so as to include all the letters which represent absolute quantities in a given algebra, whether it be a complete or an incomplete quadrate, has the peculiar character of being idempotent, and of leaving any factor unchanged with which it is combined as multiplier or multiplicand. This is the distinguishing property of unity, so that this combination of the vids can be regarded as unity, and may be introduced as such and called the *vid of unity*. There is no other combination which possesses this property.

But either of the vids $(A:A)$, $(B:B)$, &c., or the sum of any of these vids is idempotent. There are many other idempotent combinations, such as

$$(A:A) + x\ (A:B),\ y\ (A:B) + (B:B),$$
$$\tfrac{1}{2}\ (A:A) + \tfrac{1}{2}\ (A:B) + \tfrac{1}{2}\ (B:A) + \tfrac{1}{2}\ (B:B),$$

which may deserve consideration in making transformations of an algebra preparatory to its application.

INVERSION.

A vid, which differs from unity, but of which the square is equal to unity, may be called a *vid of inversion.* For such a vid when applied to some other combination transforms it; but, whatever the transformation, a repetition of the application restores the combination to its primitive form. A very general form of a vid of inversion is

$$(A:A) \pm (B:B) \pm (C:C) \pm \&c.,$$

in which each doubtful sign corresponds to two cases, except that at least one of the signs must be negative. The negative of unity might also be regarded as a symbol of inversion, but cannot take the place of an independent vid. Besides the above vids of inversion, others may be formed by adding to either of them a vid consisting of two different letters, which correspond to two of the one-lettered vids of different signs; and this additional vid may have any numerical coefficient whatever. Thus

$$(A:A) + (B:B) - (C:C) + x\,(A:C) + y\,(B:C)$$

is a vid of inversion.

The new vid which Professor Clifford has introduced into his biquaternions is a vid of inversion.

SEMI-INVERSION.

A vid of which the square is a vid of inversion, is a *vid of semi-inversion.* A very general form of a vid of semi-inversion is

$$(A:A) \pm (B:B) \pm \sqrt{-1}\,(C:C) \pm \&c.$$

in which one or more of the terms $(A:A)$, $(B:B)$, &c., have $\sqrt{-1}$ for a coefficient. The combination

$$(A:A) \pm \sqrt{-1}\,(B:B) + \tfrac{1}{2}(m \pm \sqrt{-1})\,(A:B)$$

is also a vid of semi-inversion. With the exception of unity, all the vids of Hamilton's quaternions are vids of semi-inversion.

THE USE OF COMMUTATIVE ALGEBRAS.

Commutative algebras are especially applicable to the integration of differential equations of the first degree with constant coefficients. If i, j, k, &c., are the vids of such an algebra, while x, y, z, &c., are independent variables, it is easy to show that a solution may have the form $F\,(xi + yj + zk + \&c.)$, in which F is an arbitrary

function, and i, j, k, &c., are connected by some simple equation. This solution can be developed into the form

$$F(xi + yj + zk + \&c.) = Mi + Nj + Pk + \&c.$$

in which M, N, P, &c., will be functions of x, y, z, &c., and each of them is a solution of the given equation. Thus in the case of Laplace's equation for the potential of attracting masses, the vids must satisfy the equation

$$i^2 + j^2 + k^2 = 0.$$

The algebra (a^3) of which the multiplication table is

	i	j	k
i	i	j	k
j	j	k	0
k	k	0	0

may be used for this case. Combinations i_1, j_1, k_1 of these vids can be found which satisfy the equation

$$i_1^2 + j_1^2 + k_1^2 = 0,$$

and if the functional solution

$$F(xi_1 + yj_1 + zk_1)$$

is developed into the form of the original vids

$$Mi + Nj + Pk.$$

M, N, and P will be independent solutions, of such a kind that the surfaces for which N and P are constant will be perpendicular to that for which M is constant, which is of great importance in the problems of electricity.

THE USE OF MIXED ALGEBRAS.

It is quite important to know the various kinds of pure algebra in making a selection for special use, but mixed algebras can also be used with advantage in certain cases. Thus in Professor Clifford's biquaternions of which he has demonstrated the great value, other vids can be substituted for unity, and his new vid, namely their half sum and half difference, and each of the original vids of the quaternions, can be multiplied by these, giving us two sets of vids, each of which will con-

stitute an independent quadruple algebra of the same form with quaternions. Thus if i, j, k, are the primitive quaternion vids and w the new vid. Let

$$\begin{array}{ll} \alpha_1 = \tfrac{1}{2}(1+w). & \alpha_2 = \tfrac{1}{2}(1-w). \\ i_1 = \alpha_1 i. & i_2 = \alpha_2 i. \\ j_1 = \alpha_1 j. & j_2 = \alpha_2 j. \\ k_1 = \alpha_1 k. & k_2 = \alpha_2 k. \end{array}$$

Then since

$$\begin{array}{ll} \alpha_1^2 = \alpha_1. & \alpha_2^2 = \alpha_2. \\ i_1^2 = j_1^2 = k_1^2 = -\alpha_1. & i_2^2 = j_2^2 = k_2^2 = -\alpha_1. \\ i_1 j_1 = k_1 = -j_1 i_1. & i_2 j_2 = k_2 = -j_2 i_2. \\ j_1 k_1 = i_1 = -k_1 j_1. & j_2 k_2 = i_2 = -k_2 j_2. \\ k_1 i_1 = j_1 = -i_1 k_1. & k_2 i_2 = j_2 = -i_2 k_2. \end{array}$$

$$\alpha_1 \alpha_2 = 0 = \alpha_2 \alpha_1.$$
$$M_1 N_2 = 0 = N_2 M_1.$$

in which M_1 denotes any combination of the vids of the first algebra, and N_2 any combination of those of the second algebra. It may perhaps be claimed that these algebras are not independent, because the sum of the vids α_1 and α_2 is absolute unity. This, however, should be regarded as a fact of interpretation which is not apparent in the defining equations of the algebras.

XVI.

OPTICAL NOTICES.

By Wolcott Gibbs, M.D.

Presented, April 13, 1875.

I.—ON A NEW OPTICAL CONSTANT.

When a plate of glass with plane and parallel surfaces is placed in the field of the spectroscope in such a manner that one half of the bundle of rays incident upon the first surface of the prism passes through the glass, a series of interference bands will be seen in the spectrum, known from their discoverer as Talbot's bands. When the mean index of refraction of the glass plate is less than the mean index of the prism, the plate must be so placed as to receive the rays which fall upon the prism nearest its refracting edge; in the opposite case, so as to receive the rays which fall upon the prism nearest its base. A plate of any transparent medium not doubly refracting may be made to exhibit similar bands in the spectrum. Doubly refràcting plates produce two sets of bands, corresponding respectively to the ordinary and extraordinary rays. In any isotropic substance, the number of bands, τ, between any two lines in the spectrum the indices of which are n_2 and n_1, may be found from the expression,

$$\tau = \theta \left\{ (n_2 - 1) \frac{1}{\lambda_2} - (n_1 - 1) \frac{1}{\lambda_1} \right\}$$

in which θ represents the thickness of the plate, and λ_2 and λ_1 the wave lengths in air of the two rays corresponding to n_2 and n_1.

The formula which I have given is familiar to all who have paid attention to the beautiful and fertile theory of interferences. It forms the starting-point of my investigation.

If we take θ as unity, the formula

$$\tau = (n_2 - 1) \frac{1}{\lambda_2} - (n_1 - 1) \frac{1}{\lambda_1}$$

will give the number of dark bands for a plate having the unit of thickness, which, if λ_2 and λ_1 be expressed in fractions of a millimeter, will

be one millimeter. If now we divide the expression given by the density of the substance of which the plate is composed, d, we shall have

$$I = \frac{\tau}{d} = \frac{1}{d}\left\{ (n_2 - 1)\frac{1}{\lambda_2} - (n_1 - 1)\frac{1}{\lambda_1} \right\}$$

The quantity I, as thus defined, I call the "interferential constant." It expresses the number of bands in the spectrum between two rays the indices of which for the given plate are n_2 and n_1, for a thickness of the plate equal to a unit of density. I shall endeavor to show, by the discussion of a number of observations, that the quantity I is for each substance a characteristic optical function which, for all the cases which the present state of science enables us to discuss, is independent of the temperature, and which may therefore be regarded as a new physical constant.

For the purpose of testing the character and value of the new constant, I have selected the extensive series of observations made by Wüllner* in his examination of the function $\frac{n-1}{d}$, a function which Landolt and Dale and Gladstone in their extended investigations have assumed to be constant for the same ray and the same substance. Wüllner determined with great care the indices of refraction of a series of liquids for the three hydrogen lines C, F, and G at different temperatures, together with the corresponding densities. He found that, for very considerable ranges of temperature, the three indices and the corresponding densities could be represented very closely by linear functions of the form $n = n_0 - kt$ and $d = d_0 - bt$. Wüllner's general results are given in Table I., in which $N\alpha$ and $N\gamma$ represent the indices of refraction at 0° C for the rays C and G, d and T the corresponding densities and temperatures.

With the data here reproduced, Wüllner computed for each liquid the value of the function $\frac{A-1}{D}$, in which A represents the term in Cauchy's formula

$$n = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4},$$

which is independent of the wave length, and D the density. The general result of his investigation is that the functions $\frac{A-1}{D}$ or $\frac{n-1}{d}$ cannot be regarded as perfectly constant, either when the densities are made to vary by heating or cooling or by mixing one liquid with another.

* Pogg. Ann., T. 133, p. 1.

TABLE I.

SUBSTANCE.	$Na - k\,T.$	$N\gamma - k'T.$	$d - b\,T.$
Water	1.333188 — 0.000099 T	1.342290 — 0.000099 T	— — — —
Alcohol	1.368431 — 0.000389 T	1.378158 — 0.000395 T	0.81328 — 0.000850 T
Glycerine a	1.453177 — 0.000265 T	1.465064 — 0.000267 T	1.23454 — 0.000630 T
„ 3.7 Water 1	1.426172 — 0.000281 T	1.487604 — 0.000233 T	1.18598 — 0.000557 T
„ 1. „ 1	1.389760 — 0.000185 T	1.400239 — 0.000187 T	1.11500 — 0.000444 T
„ 0.5 „ 1	1.369609 — 0.000154 T	1.379567 — 0.000156 T	1.07549 — 0.000365 T
Glycerine b	1.463651 — 0.000270 T	1.475782 — 0.000272 T	1.25073 — 0.000635 T
„ 4. Alcohol 1	1.442453 — 0.000292 T	1.454235 — 0.000296 T	1.14155 — 0.000660 T
„ 2. „ 1	1.428029 — 0.000305 T	1.439160 — 0.000310 T	1.07420 — 0.000725 T
„ 0.998 „ 1	1.411538 — 0.000330 T	1.422213 — 0.000336 T	0.99748 — 0.000750 T
„ 0.4997 „ 1	1.398365 — 0.000356 T	1.408848 — 0.000363 T	0.93710 — 0.000805 T
Conc. Solution of $ZnCl_2$	1.509257 — 0.000288 T	1.528169 — 0.000291 T	1.96816 — 0.001158 T
„ 3.997 Water 1	1.460379 — 0.000266 T	1.476405 — 0.000268 T	1.68519 — 0.000992 T
„ 1.9996 „ 1	1.433093 — 0.000258 T	1.447567 — 0.000261 T	1.52457 — 0.000882 T
„ 0.9998 „ 1	1.404593 — 0.000250 T	1.417494 — 0.000252 T	1.36623 — 0.000793 T
Carbonic Disulphide	1.634066 — 0.000780 T	1.692149 — 0.000850 T	1.29366 — 0.001506 T
„ 3.955 Alcohol 1	1.551274 — 0.000678 T	1.594015 — 0.000750 T	1.14918 — 0.001373 T
„ 2.12836 „ 1	1.512477 — 0.000626 T	1.547691 — 0.000680 T	1.08033 — 0.001294 T
„ 1.03111 „ 1	1.465695 — 0.000560 T	1.492206 — 0.000590 T	0.99538 — 0.001178 T

Taking the data of Table I., I have computed the values of the interferential constant I for at least three different temperatures in the case of each liquid. Five determinations are given in the case of water, and four in the case of carbonic disulphide. As the density of water, even for a limited range of temperature, cannot be expressed by a linear function, I have computed it from the volumes as given by Pierre. My general results are given in Table II.

TABLE II.

WATER.

N_a.	N_γ.	T.	d.	I.	τ.
1.333138	1.342290	0°	1.00000	287.1	287.0
1.332148	1.341300	10°	0.99988	286.3	286.3
1.331158	1.340310	20°	0.99839	285.9	285.5
1.330168	1.339320	30°	0.99588	285.8	284.7
1.329178	1.338330	40°	0.99250	285.8	282.9
			Mean,	286.2	

$\tau = 287.0 - 0.0775\,T.$

CARBONIC DISULPHIDE.

N_a.	N_γ.	T.	d.	I.	τ.
1.634066	1.692149	0°	1.29366	495.2	640.7
1.622366	1.679399	15°	1.27107	494.8	628.9
1.610666	1.666649	30°	1.24848	494.3	617.1
1.596626	1.651349	48°	1.22137	493.6	603.0
			Mean,	494.77	

$\tau = 640.7 - 0.7853\,T.$

ALCOHOL.

N_a.	N_γ.	T.	d.	I.	τ.
1.368431	1.378158	0°	0.81281	389.4	316.5
1.362596	1.372233	15°	0.80003	389.5	311.6
1.356761	1.366308	30°	0.78731	389.6	306.7
			Mean,	389.5	

$\tau = 316.5 - 0.3266\,T.$

CHLORIDE OF ZINC.

Saturated solution of $ZnCl_2$.

N_a.	N_γ.	T.	d.	I.	τ.
1.509257	1.528169	0°	1.96816	228.7	450.2
1.503497	1.522349	20°	1.94510	228.9	445.4
1.497737	1.516529	40°	1.92204	229.2	440.7
			Mean,	228.9	

$\tau = 450.2 - 0.2375\,T.$

Water, 1. Sat. solution of $ZnCl_2$, 3.997.

N_a.	N_γ.	T.	d.	I.	τ.
1.460379	1.476405	0°	1.68519	239.9	404.3
1.455059	1.471045	20°	1.66535	240.3	400.2
1.449739	1.465685	40°	1.64551	240.5	395.8
			Mean,	240.2	

$\tau = 404.3 - 0.2125\,T.$

TABLE II. (*continued*).

Chloride of Zinc.

Water, 1. Sat. solution of $ZnCl_2$, 1.9996.

N_α.	N_γ.	T.	d.	I.	τ.
1.433093	1.447567	0°	1.52457	248.6	379.1
1.427933	1.442347	20°	1.50693	248.7	374.8
1.422773	1.437127	40°	1.48929	248.8	370.6
			Mean,	248.7	

$\tau = 379.1 - 0.2125\ T.$

Water, 1. Sat. solution of $ZnCl_2$, 0.9998.

1.404593	1.417494	0°	1.36623	258.2	352.7
1.399593	1.412454	20°	1.35037	258.2	348.7
1.394593	1.407414	40°	1.33451	258.2	344.6
			Mean,	258.2	

$\tau = 352.7 - 0.2025\ T.$

Glycerine *a* and Water.

Glycerine *a*.

1.453177	1.465064	0°	1.23454	315.2	389.1
1.449202	1.461059	15°	1.22509	314.9	385.9
1.446552	1.458389	25°	1.21879	314.8	383.7
1.442577	1.454384	40°	1.20934	314.6	380.5
			Mean,	314.9	

$\tau = 389.1 - 0.2150\ T.$

Water, 1. Glycerine, 3.7.

1.426172	1.437604	0°	1.18598	309.1	366.6
1.422456	1.434109	15°	1.17763	309.2	364.1
1.420397	1.431779	25°	1.17206	308.8	361.8
1.416932	1.428284	40°	1.16370	308.5	359.0
			Mean,	309.0	

$\tau = 366.6 - 0.1900\ T.$

Water, 1. Glycerine, 1.

1.389760	1.400289	0°	1.11500	300.7	335.8
1.386985	1.397484	15°	1.10834	300.4	333.0
1.385185	1.395564	25°	1.10390	300.2	331.4
1.382360	1.392759	40°	1.09724	299.9	329.1
			Mean,	300.4	

$\tau = 335.8 - 0.1550\ T.$

Water, 1. Glycerine, ½.

1.369609	1.379567	0°	1.07549	295.6	317.9
1.367299	1.377227	15°	1.07002	295.3	316.0
1.365759	1.375667	25°	1.06637	295.2	314.8
1.363449	1.373327	40°	1.06089	294.9	312.9
			Mean,	295.2	

$\tau = 317.9 - 0.1250\ T.$

TABLE II. (*continued*).

GLYCERINE *b* AND ALCOHOL.

N_a.	N_γ.	T.	d.	I.	τ.
Glycerine *b*.					
1.463651	1.475782	0°	1.25078	818.2	898.0
1.459601	1.471652	15°	1.24120	817.9	894.6
1.455551	1.467572	30°	1.23160	317.7	891.8
				Mean, 817.9	
				$\tau = 898.0 - 0.2233\ T$.	
Alcohol, 1.	Glycerine *b*, 4.				
1.442453	1.454235	0°	1.14155	833.0	380.2
1.438073	1.449795	15°	1.13165	832.8	876.6
1.433693	1.445355	30°	1.12175	332.5	873.0
				Mean, 832.7	
				$\tau = 380.2 - 0.2400\ T$.	
Alcohol, 1.	Glycerine, 2.				
1.428029	1.439160	0°	1.07420	842.0	867.4
1.423454	1.434510	15°	1.06333	841.9	863.5
1.418879	1.429860	30°	1.05245	841.7	859.6
				Mean, 341.9	
				$\tau = 367.4 - 0.2600\ T$.	
Alcohol, 1.	Glycerine, 0 998.				
1.411538	1.422213	0°	0.99750	853.9	853.1
1.406588	1.417173	15°	0.98623	853.8	848.9
1.401638	1.412133	30°	0.97498	853.5	844.6
				Mean, 353.7	
				$\tau = 353.1 - 0.2833\ T$.	
Alcohol, 1.	Glycerine, 0.4997.				
1.398365	1.408848	0°	0.93710	864.4	841.5
1.393025	1.403408	15°	0.92503	864.9	837.5
1.387685	1.397958	30°	0.91295	864.8	833.0
				Mean, 364.7	
				$\tau = 341.5 - 0.2853\ T$.	

ALCOHOL AND CS_2.

N_a.	N_γ.	T.	d.	I.	τ.
Alcohol, 1.	CS_2, 3.955.				
1.551274	1.594015	0°	1.149130	468.9	538.9
1.541104	1.582765	15°	1.128540	468.1	528.3
1.530934	1.571515	30°	1.107940	467.7	517.7
				Mean, 468.2	
				$\tau = 538.9 - 0.7066\ T$.	
Alcohol, 1.	CS_2, 2.12836.				
1.512477	1.547691	0°	1.080130	454.2	490.6
1.503087	1.537491	15°	1.060720	453.7	481.2
1.493697	1.527291	30°	1.041310	453.1	471.9
				Mean, 453.7	
				$\tau = 490.6 - 0.6233\ T$.	

TABLE II. (*continued*).

ALCOHOL AND CS_2.

Alcohol, 1. CS_2, 1.03111.

N_a.	N_γ.	T.	d.	I.	τ.
1.465695	1.492206	0°	0.995830	435.0	433.0
1.457295	1.483356	15°	0.977660	435.0	425.3
1.448895	1.474506	30°	0.959990	434.9	417.5
			Mean,	435.0	

$\tau = 433 - 0.5166\,T$.

In this table, N_a and N_γ represent the indices of refraction of the substances named at the temperature T, d the corresponding densities, and I the interferential constants. The indices and densities are computed from Wüllner's formulas given in Table I. Each of these linear formulas was deduced from a large number of direct observations made at different accurately observed temperatures. The values of the indices and densities calculated from them are therefore more reliable than those obtained by single direct observations. In the cases of all the substances examined, Table II. shows clearly that the interferential constants are, for very considerable ranges of temperature, independent of the temperature itself. Wüllner's formulas cited in Table I. show that in all cases the co-efficients k and k' are very nearly equal, so that N_a and N_γ decrease very nearly in the same ratio as the temperature rises. The formula defining the interferential constant,

$$I = \frac{1}{d}\left\{(n_2 - 1)\,\frac{1}{\lambda_2} - (n_1 - 1)\,\frac{1}{\lambda_1}\right\},$$

then shows that the densities must decrease very nearly in the same ratio with the differences of the indices, since I is constant for each substance. A careful examination of the values of the interferential constants given in Table II. shows that in some cases the values diminish very slowly as the temperature increases, suggesting that in these the quantity I is a linear function of the temperature. It will, however, be remarked that the diminution noticed is in the first place extremely small, and secondly that it is not uniformly present. I consider myself, therefore, fully justified in considering I as constant for each substance. In the particular case of carbonic disulphide, I have computed its value for 48° C., which is the boiling-point of the liquid. It will be remarked that, in the case of this substance, the diminution of I with the temperature is quite uniform, but that the total diminution for 48° is only 0.32 % of the value at 0°. It must, furthermore, be remembered that it is scarcely probable that the density of the disul-

phide can be represented for so great a range of temperature by a linear function. The same remark of course applies to the other liquids examined, though in a less degree. With respect to the determination of I by observation, I may here remark that, although the interference bands between any two spectral lines may be directly counted, so that the spectroscope alone is available, it will still be better, whenever possible, to measure the two indices directly, and then compute I with the assistance of an observed density. It will be seen that τ is for each substance a linear function of the temperature.

For laboratory purposes, the interferential constant will, I hope, like the density, boiling-point, specific volume, &c., serve as a means of recognizing the purity of a given compound. I shall now endeavor to show that it may also find application in quantitative analysis.

The values of I given above are sufficient to prove that the interferential constant of a mixture is the sum of the interferential constants of the component parts. If P be the weight of any mixture, p_1 and p_2 the relative weights of its components, I the constant for the mixture, I_1 and I_2 the constants for the components, we shall have

$$PI = p_1 I_1 + p_2 I_2$$

Table III. contains the values of PI as obtained directly from the observed values of P and I, and also as computed by adding the values of $p_1 I_1$ and $p_2 I_2$ in the cases of all the mixtures cited in Tables I. and II.

TABLE III.

					Percentages.			
Water.	$ZnCl_2$.	PI.	$p_1 I_1 + p_2 I_2$	ϵ%	Cal'd.	Found.	Cal'd.	Found.
1.0000	3.9970	1201.0	1201.8	+0.06	19.95	19.72	80.05	80.28
1.0000	1.9996	746.1	744.0	—0.27	33.32	34.55	66.68	65.45
1.0000	0.9998	516.4	515.1	—0.27	50.01	51.13	49.99	48.87
Water.	Glycerine a.				Water.		Glycerine.	
1.0000	3.7000	1452.8	1451.3	—0.07	21.28	20.56	78.72	79.44
1.0000	1.0000	600.8	601.1	+0.05	50.00	50.52	50.00	49.48
1.0000	0.5000	442.8	443.7	+0.20	66.67	68.64	33.33	31.36
Alcohol.	Glycerine b.				Alcohol.		Glycerine.	
1.0000	4.0000	1663.5	1661.1	—0.15	20.00	20.67	80.00	79.33
1.0000	2.0000	1025.7	1025.3	—0.04	33.33	33.52	66.67	66.48
1.0000	0.9980	706.7	706.7	0.00	49.95	50.00	50.05	50.00
1.0000	0.4997	547.5	548.4	+0.16	66.68	65.36	33.32	34.64
Alcohol.	CS_2.				Alcohol.		CS_2.	
1.0000	3.95500	2319.9	2346.4	+1.14	20.18	25.26	79.82	74.74
1.0000	2.12836	1419.3	1442.6	+1.64	31.65	39.03	68.35	66.97
1.0000	1.03111	883.5	899.7	+1.83	49.24	43.21	50.76	56.79

Column 5 gives the differences between the values of PI and $(p_1 I_1 + p_2 I_2)$ in percentages of PI. Columns 6, 7, 8, and 9 give the percentages of the constituents of each mixture, as deduced from the proportions taken by Wüllner and given in Table II., and the percentages as calculated by the formula

$$100\,I = a\,I_1 + (100 - a)\,I_2.$$

In examining Table III., it will be seen that in the cases of mixtures of water and chloride of zinc, of water and glycerine, and of alcohol and glycerine, the differences between the values of PI and $(p_1 I_1 + p_2 I_2)$ in no case exceed 0.27%, and that the signs of the differences are about as often plus as minus. The comparison of the observed and calculated percentages is less satisfactory, but is still sufficient to show that the method is available in analyses of mixtures of liquids in which extreme precision is not required and for which purely chemical methods are wanting.

But with mixtures of alcohol and carbonic disulphide the case is otherwise. The differences between the value of PI and $(p_1 I_1 + p_2 I_2)$ amount as a minimum to 1.14% and as a maximum to 1.83%. I consider it, to say the least, as probable that the mixture of alcohol and the disulphide is accompanied by chemical action resulting in the formation of new compounds. Wüllner found that these mixtures, after standing overnight in well stoppered bottles, gave indices of refraction differing materially from those of the freshly prepared solutions, the differences being too large to be accounted for by a loss of carbonic disulphide. It is difficult to explain this fact in any other way than by supposing that a chemical change begins as soon as the liquids are mixed, though no such change has been observed by chemists.

In any event, my results, I think, render it probable that the method of analysis based upon them will find useful applications. A much larger and more varied series of observations of the indices and densities of different liquids and mixtures of these in various proportions is extremely desirable. For saline solutions, we possess measurements by Sauber, Hoffmann, and others, but unfortunately the densities and indices of refraction have not, except in a very limited number of cases, been determined for the same temperatures. In the particular case of solutions of sugar, Obermayer * has given the following values for the indices of refraction and densities, at 22.26 C.: —

* Wien. Acad. Ber. 61 (2 Abth.) p. 797.

Line.	10% sol.	20% sol.	30% sol.
C	1.34568	1.36085	1.37800
G	1.35541	1.37167	1.38923
Densities	1.03812	1.08034	1.12639
I	287.4	288 2	289.7
I'	295.4	296.2	300.0

In this table, I gives the interferential constants for the three solutions, I' the constant for the liquid sugar in each, the mean value being 297.2. As the interferential constant for water is 286.2, it is easy to see that nothing is to be hoped for from the employment of the interferential constant as a means of determining the quantity of sugar in a solution, since it is clear that the degree of accuracy to be attained by the method above given, will, in general terms, be in proportion to the difference between the interferential constants of the constituents of the given mixture. In its application to quantitative determinations, the new optical method is analogous to the well-known process of indirect analysis, the success of which depends upon the difference between the atomic weights of the bodies sought. Landolt has shown that the function $\frac{n-1}{d}$ is so nearly constant for a given ray and given substance, that for chemical purposes no very sensible error is made in considering it as absolutely constant. He has further shown that in the case of a mixture of two substances we have very nearly

$$\frac{N-1}{D}P=\frac{n_1-1}{d_1}p_1+\frac{n_2-1}{d_2}p_2.$$

This expression may be employed for the analysis of mixtures, and in many cases leads to valuable results, as Landolt has sufficiently shown. I am disposed to think that the method which I have proposed above will enable us to obtain a still greater degree of accuracy in cases in which the values of the interferential constants have been determined with the requisite precision.

The valuable data furnished by Wüllner are not the only ones which I have discussed. * Landolt and Haagen have also given a series of measurements of the densities and indices of refraction of a number of liquids. Their results are contained in Table IV.; I have arranged them for convenience in six groups, the sixth group containing the data furnished by Haagen.†

* Pogg. Annalen, T. 122, p. 545.

† Pogg. Annalen, T. 131, p. 117.

TABLE IV.

Name.	Formula.	Density at 20° C.	Na.	Nγ.	r.	L.	Ml.
Water	H_2O	0.9984	1.33111	1.34038	285.7	286.2	51.5
Formic Acid	CH_2O_2	1.2211	1.36927	1.38041	320.4	262.3	120.6
Acetic „	$C_2H_4O_2$	1.0514	1.36985	1.38017	319.0	303.4	182.0
Propionic „	$C_3H_6O_2$	0.9963	1.38460	1.39518	331.8	332.5	246 0
Butyric „	$C_4H_8O_2$	0.9610	1.39554	1.40649	341.9	354.7	312.1
Valeric „	$C_5H_{10}O_2$	0.9318	1.40220	1.41349	347.0	372.6	380.0
Capronic „	$C_6H_{12}O_2$	0.9252	1.41164	1.42323	355.2	383.9	445.3
Œnanthic „	$C_7H_{14}O_2$	0.9175	1.41923	1.43106	361.9	394.4	512.7
Methyl Alcohol	CH_4O	0.7964	1.32789	1.33621	280.9	352.7	112.9
Ethyl „	C_2H_6O	0.8011	1.36054	1.36997	309.5	386.3	177.7
Propyl „	C_3H_8O	0.8042	1.37938	1.38982	325.7	404.9	242.9
Butyl „	$C_4H_{10}O$	0.8074	1.39395	1.40447	338.7	419.4	310.3
Amyl „	$C_5H_{12}O$	0.8135	1.40573	1.41689	349.6	429.7	378.1
Methylic Acetate	$C_3H_6O_2$	0.9053	1.35915	1.36893	309.2	341.5	252.0
Ethylic Formate	$C_3H_6O_2$	0.9078	1.35800	1.36782	308.4	339.7	251.4
Ethylic Acetate	$C_4H_8O_2$	0.9021	1.37068	1.38067	318.9	353.5	311.1
Methylic Butyrate	$C_5H_{10}O_2$	0.8976	1.38698	1.39742	333.2	371.2	378.6
Methylic Valerate	$C_6H_{12}O_2$	0.8809	1.39272	1.40370	338.8	384.6	446.2
Ethylic Butyrate	$C_6H_{12}O_2$	0.8906	1.39404	1.40460	338.9	384.8	446.4
Amylic Formate	$C_6H_{12}O_2$	0.8816	1.39592	1.40689	341.3	387.1	449.0
Ethylic Valerate	$C_7H_{14}O_2$	0.8674	1.39500	1.40588	322.7	372.0	483.5
Amylic Acetate	$C_7H_{14}O_2$	0.8574	1.40168	1.41271	346.0	403.5	524.4
Amylic Valerate	$C_{10}H_{20}O_2$	0.8581	1.40978	1.42124	353.5	411.9	708.4
Aldehyd	C_2H_4O	0.7810	1.32975	1.33987	285.3	365.3	160.7
Valeral	$C_5H_{10}O$	0.7995	1.38614	1.39729	333.9	417.4	359.0
Acetone	C_3H_6O	0.7981	1.35715	1.36780	309.6	390.3	226.4

TABLE IV. (continued.)

Name	Formula	Density at 20° C.	N_α	N_γ	r.	l.	Ml.
Ethylic Ether	$C_4\ H_{10}\ O$	0.7166	1.35112	1.36071	801.7	421.0	811.5
Acetic Anhydrid	$C_4\ H_6\ O_3$	1.0826	1.38832	1.39327	835.2	809.3	816.4
Ethylene Alcohol	$C_2\ H_6\ O_2$	1.1092	1.42580	1.43662	865.5	829.5	204.8
Ethylene Acetate	$C_6\ H_{10}\ O_4$	1.1583	1.41932	1.43120	862.0	812.5	456.2
Glycerine	$C_3\ H_8\ O_3$	1.2615	1.47068	1.48281	403.7	820.0	294.4
Lactic Acid	$C_3\ H_6\ O_3$	1.2427	1.43915	1.45185	878.6	804.6	274.1
Phenol	$C_6\ H_6\ O$	1.0722	1.54447	1.57555	506.5	472.4	440.0
Bitter-almond Oil	$C_7\ H_6\ O$	1.0474	1.53914	1.57749	519.1	495.5	555.2
Salicylous Acid	$C_7\ H_6\ O_2$	1.1698	1.56467	1.62008	579.1	495.2	604.1
Methyl-salicylous Acid . .	$C_8\ H_8\ O_3$	1.1824	1.53019	1.56718	508.8	430.3	654.0
Methyl-benzoate	$C_8\ H_8\ O_2$	1.0882	1.51158	1.53989	478.8	435.4	592.1
Ethyl-benzoate	$C_9\ H_{10}\ O_2$	1.0491	1.50104	1.52749	461.1	439.5	659.2
Carbonic Tetrachloride . .	$C\ Cl_4$	1.5947	1.457890	1.472900	400.2	250.9	386.4
Chloroform	$C\ H\ Cl_3$	1.4930	1.444030	1.458210	387.1	259.2	309.7
Chloride of Ethylene . . .	$C_2\ H_4\ Cl_2$	1.2562	1.442010	1.455110	383.0	225.2	222.9
Ethylic Bromide	$C_2\ H_5\ Br$	1.4600	1.421820	1.436290	368.5	252.4	275.1
Amylic Bromide	$C_5\ H_{11}\ Br$	1.2045	1.438560	1.452940	384.8	319.4	482.3
Bromide of Ethylene . . .	$C_2\ H_4\ Br_2$	2.1827	1.533890	1.556580	478.7	219.8	412.3
Methylic Iodide	$C\ H_3\ I$	2.2636	1.524840	1.553870	486.9	215.0	305.3
Ethylic Iodide	$C_2\ H_5\ I$	1.9350	1.508120	1.534370	466.3	240.9	375.8
Amylic Iodide	$C_5\ H_{11}\ I$	1.4734	1.487140	1.507080	434.9	295.1	584.3
Phosphorous Chloride . .	$P\ Cl_3$	1.5774	1.508810	1.524490	443.1	280.9	386.2
Arsenic Chloride	$As\ Cl_3$	2.1668	1.592000	1.624800	548.4	253.1	459.4
Stannic Chloride	$Sn\ Cl_4$	2.2328	1.507000	1.531800	462.0	206.9	537.9
Silicic Chloride	$Si\ Cl_4$	1.4878	1.411900	1.424400	357.6	240.3	408.5
Sodic Chloride	$Na\ Cl$	2.1548	1.540460	1.560560	477.8	221.8	129.8
Potassic Chloride	$K\ Cl$	1.9950	1.487270	1.505720	481.6	216.8	161.1

In this Table, the seventh column gives the values of the interferential constant *I*. The eighth is obtained by multiplying the numbers in column six by the molecular weights of the corresponding substances, divided by 100, so as to avoid many figures. The product *M I* gives, therefore, the number of interference bands between *C* and *G* for a thickness of each liquid proportioned to its molecular weight.

I have employed the measurements of Landolt and Haagen in discussing the question whether the interferential constant of a definite chemical compound is the sum of the interferential constants of its constituent atoms. Table V. exhibits the methods and results of this discussion.

TABLE V.

Acids.	*M I*	Δ_1	*C*	Δ_2	Δ%
$C\ H_2\ O_2$ . . .	120.6		119.7	−0.9	−0.74
		61.4			
$C_2\ H_4\ O_2$ . . .	182.0		184.8	+2.8	+1.53
		64.0			
$C_3\ H_6\ O_2$ . . .	246.0		249.9	+3.9	+1.22
		66.1			
$C_4\ H_8\ O_2$ . . .	312.1		315.1	+3.0	+0.96
		67.9			
$C_5\ H_{10}\ O_2$ . . .	380.0		380.2	+0.2	+0.05
		65.3			
$C_6\ H_{12}\ O_2$ . . .	445.3		445.4	+0.1	+0.02
		67.4			
$C_7\ H_{14}\ O_2$ . . .	512.7		510.5	−2.2	−0.42
	Mean	65.3		Mean	0.70
Alcohols.					
$H_2\ O$ . . .	51.4		50.9	−0.5	−0.97
		61.5			
$C\ H_4\ O$ . . .	112.9		116.2	+3.3	+2.92
		64.8			
$C_2\ H_6\ O$ . . .	177.7		181.2	+3.5	+1.97
		65.2			
$C_3\ H_8\ O$ . . .	242.9		246.3	+3.4	+1.40
		67.4			
$C_4\ H_{10}\ O$ . . .	310.3		311.5	+1.2	+0.38
		67.8			
$C_5\ H_{12}\ O$ . . .	378.1		376.6	−1.5	−0.39
	Mean	65.3		Mean	1.34
Ethers.					
$C_3\ H_6\ O_2$ . . .	251.7		250.0	−1.7	−0.67
		59.4			
$C_4\ H_8\ O_2$ . . .	311.1		313.1	+2.0	+0.64
		67.5			
$C_5\ H_{10}\ O_2$ . . .	378.6		380.2	+1.6	+0.42
		68.6			
$C_6\ H_{12}\ O_2$ . . .	447.2		445.4	−1.8	−0.40
		4 × 65.3			
$C_{10}\ H_{20}\ O_2$ . . .	708.4		705.9	−2.5	−0.35
	Mean	65.2		Mean	0.50

In this table, column second gives the interferential equivalent of the liquid, the formula of which is given in column first. Column Δ_1 gives the differences of the interferential equivalents for the constant chemical difference CH_2; the liquids of each group being homologous. It will be at once seen that Δ_1 is not constant in any one group, but increases with the molecular weight of the liquid. From this it follows that the interferential equivalents of either carbon or hydrogen, or of both, are variable. The last case is most probable. The mean of the differences Δ_1 is the same for all these groups. From the above it is easy to see that in the strict sense neither carbon nor hydrogen can be said to possess a constant interferential equivalent. As it seemed, however, practicable in this case, as in the case of the refractive equivalents, to deduce, at least, an available rule for computing approximately the interferential equivalent of a compound from the equivalents of its constituent atoms, I determined the equivalents of carbon, hydrogen, and oxygen by means of the data given in Table V. and obtained the following values: —

Carbon	41.46
Hydrogen	11.84
Oxygen	27.28

With these values I computed the numbers of column C in Table V. and of the fourth column in Table VI.

TABLE VI.

Name.	Formula.	Found.	Calc'd.	Δ_2	$\Delta\%$
Aldehyd . . .	C_2H_4O	160.7	157.6	-3.1	-1.92
Valeral	$C_5H_{10}O$	359.0	353.0	-6.0	-1.69
Acetone . . .	C_3H_6O	226.4	222.7	-3.7	-1.63
Ethyl-ether . .	$C_4H_{10}O$	311.5	311.5	0.0	0.00
Acetic Anhyd. .	$C_4H_6O_3$	316.4	318.7	$+2.3$	$+0.72$
Ethylen Alc. . .	$C_2H_6O_2$	204.3	208.5	$+4.2$	$+2.05$
Biacet. ethylene .	$C_6H_{10}O_3$	456.2	476.2	$+20.0$	$+4.39$
Glycerine . . .	$C_3H_8O_3$	294.4	300.9	$+5.5$	$+1.86$
Lactic Acid . .	$C_3H_6O_3$	274.1	277.3	$+3.2$	$+1.17$
				Mean	1.58

In these tables, column Δ_2 gives the differences between the observed and computed values in the case of each liquid, and column $\Delta\%$ the same differences in percentages of the observed values. The means of these last are also given without reference to sign. With the aid of the equivalents of carbon and hydrogen, I determined those of chlorine, bromine, and iodine, given in Table VIII. Finally, the equivalents of

carbon and chlorine gave those of the other elements in the same table. Columns fourth, fifth, and sixth, in Table VII., have the same signification as the corresponding columns of Tables V. and VI.

TABLE VII.

Name.	Formula.	Found.	Calc'd.	Δ_2	$\Delta\%$
Carbonic tetrachloride	$C\ Cl_4$	386.4	384.8	-1.6	-0.41
Chloroform	$C\ H\ Cl_3$	309.7	310.8	$+1.1$	$+0.35$
Ethylic bromide . .	$C_2\ H_5\ Br$	275.1	281.7	$+6.6$	$+2.39$
Amylic bromide . .	$C_5\ H_{11}\ Br$	482.3	477.1	-5.2	-1.08
Ethylene bromide . .	$C_2\ H_4\ Br_2$	412.3	409.5	-2.8	-0.67
Methylic iodide . . .	$C\ H_3\ I$	305.8	313.8	$+8.0$	$+2.62$
Ethylic iodide . . .	$C_2\ H_5\ I$	375.8	378.4	$+2.6$	$+0.69$
Amylic iodide . . .	$C_5\ H_{11}\ I$	584.3	573.8	-10.5	-1.79
Carbon disulphide .	$C\ S_2$	375.7			
Phosphorous chloride	$P\ Cl_3$	386.2		Mean	1.25
Arsenous chloride . .	$As\ Cl_3$	459.4			
Stannic chloride . .	$Sn\ Cl_4$	537.9			
Silicic chloride . . .	$Si\ Cl_4$	408.5			
Sodic chloride . . .	$Na\ Cl$	129.8			
Potassic chloride . .	$K\ Cl$	161.1			

TABLE VIII.

Carbon	41.46	Phosphorus . . .	128.70
Hydrogen . . .	11.84	Arsenic	201.90
Oxygen	27.28	Tin	194.50
Chlorine	85.85	Silicon	65.10
Bromine	139.60	Potassium . . .	75.29
Iodine	236.30	Sodium	44.00
Sulphur	167.12		

The results tabulated in V., VI., and VII., are sufficient to show that the interferential equivalents of compounds may, in many cases, be computed with a tolerably close approximation from those of the constituent atoms. The approximation is, however, much less close than in the cases of mixtures. On the other hand, the rule fails entirely with certain compounds. Thus, the six liquids of the aromatic series forming group fifth of Table IV., present very marked exceptions. In these cases, no values of the interferential equivalents of carbon, hydrogen, and oxygen, can be found which will enable us to compute the molecular equivalents. Mr. Gladstone * has met with similar exceptions in the refractive equivalents of the benzol series, and suggests,

* Journal of the Chemical Society [2] Vol. 8, p. 101.

in substance, that these are probably due to the fact that, optically, each molecule may be regarded as composed of groups of atoms, each group possessing a specific optical character. So far as the interferential equivalents are concerned, further data are necessary to enable us to test this explanation.

Landolt has given the densities and indices of refraction of a number of mixtures. I have not discussed these results from my own point of view, because since the publication of his work the progress of organic chemistry has shown that many of the substances with which Landolt dealt could not have been absolutely pure, though prepared with great care for the special purpose of his investigation.* I think I have shown that the so-called interferential constants possess a real value as numerical characteristics easily determined by measurements of two indices of refraction and a single observation of density at the same temperature. But the value of the new constants in quantitative analyses can only be fairly estimated when we possess determinations of indices and densities for a series of mixtures for which the proportions, densities, and indices of the constituents are accurately known. The time has also arrived when a much greater degree of accuracy in the determination of indices of refraction is necessary. Even five decimal places do not answer the present requirements of science. Six are attainable with spectrometers reading to two seconds of arc.

It is easy to see that the numerical value of an interferential constant depends in part upon the angular distance of the spectral lines between which the bands are counted. The lines C and G are particularly well adapted for standard limits, as they are hydrogen lines always obtainable by a small Ruhmkorff coil and hydrogen tube. The interferential constant may be taken as a measure of the dispersive power of a body; and it is readily shown that with this measure, also, the total dispersive power from A to H is the sum of the partial dispersions from A to B, B to C . . . G to H. The theory and construction of achromatic lenses might also be based upon this measure of dispersive power, but it would probably possess no practical advantages over the ordinary method.

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* I refer to the improvements in separating liquids of different boiling-points introduced by Linnemann, — improvements which have shown that up to the period of his work we had no really accurate knowledge of the boiling-points of a number of liquids long known to science, but never before obtained in a state of perfect purity.

II. — ON A METHOD OF MEASURING REFRACTIVE INDICES WITHOUT THE USE OF DIVIDED INSTRUMENTS.

The importance of an accurate determination of all the physical constants which characterize any substance having a definite chemical constitution becomes daily more and more evident. The researches of Gladstone, Landolt, and others have shown that indices of refraction possess a peculiar value and interest. As the instruments necessary for their determination are expensive, and often beyond the reach of working chemists, a simple and sufficiently accurate method of measuring them by means of the spectroscope alone will doubtless be welcomed.

The method which I propose is one of comparison, and applies with convenience only to the case of liquids. A hollow prism is to be filled with the liquid to be examined, placed upon the stage of the spectroscope, and turned until a given ray — the line *D*, for instance — is seen by the observing telescope to be in the position of minimum deviation. The eye-piece of the telescope should have two parallel spider-lines placed very near each other in the plane of the diaphragm. When the dispersion is sufficiently great to separate the line *D* into its two components, either component may be made to bisect the interval between the two spider-lines, or the two components may be made to occupy such positions that their middle line shall bisect the interval. The observing telescope is then to be firmly clamped. The prism is now to be removed, the liquid poured out, and the prism cleaned and dried carefully. It is then to be filled with any liquid the indices of refraction of which are known, and which the observer judges to have a mean index not greatly differing from that of the liquid to be measured. The prism is to placed upon the stage of the spectroscope, and turned until the observer ascertains that the two spectra would be in the field of view if both could be seen at the same time; or, what is the same thing, that they would be more or less completely superposed. Should this not be the case, another comparison-liquid must be chosen; and so on until one is found which fulfils the requisite conditions. Supposing that this is successfully accomplished, the prism is to be turned until, for the position of minimum deviation, a known line in the spectrum exactly bisects the interval between the two spider-lines. The index of refraction of the given liquid for the line *D* is

then the same as that of the known line in the spectrum of the liquid used for comparison; for we have for each case

$$n = \frac{\sin \frac{1}{2}(P + D)}{\sin \frac{P}{2}} \quad n' = \frac{\sin \frac{1}{2}(P + D')}{\sin \frac{P}{2}}$$

and, since P is constant, and $D' = D$, it follows that $n' = n$.

By this method, the index of refraction of a given liquid may be determined for a single line; as, for instance, for D. This is sufficient for the optical analysis in the form in which it has been developed by Landolt. Two objections to this method present themselves at once. The first is the necessity of finding by tentative processes a comparison-liquid which shall have about the same mean index of refraction as the liquid an index of which is to be determined. I admit the force of the objection, but it must not be estimated too highly. Whole classes of liquids agree pretty nearly in their optical characters; as, for instance, the oils of the $C_{10} H_{16}$ series, the ethers of the fatty acids, hydrocarbons and saline solutions. The second objection is that, with liquids of low dispersive powers, it is not easy to distinguish the spectral lines with absolute certainty. This difficulty is easily avoided by using a second prism, with a high dispersive power, placed next to the collimator so as to form a long spectrum, which shall fall upon the trial-prism. The final dispersion is then the sum of the dispersions of the two prisms, and no difficulty will be found in distinguishing the spectral lines. It is, of course, necessary that the subsidiary prism shall have the same position in both cases. Two or more subsidiary prisms either of flint-glass or of carbonic disulphide may be used with great advantage, but one will usually be found sufficient. The indices of refraction of the comparison-liquids being known for at least three lines, the values of the constants a, b, and c in Cauchy's formula

$$n = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4}$$

may be determined. It then only remains to compute the index of refraction of the line which has been found to have the same index as the line D, for instance, of the liquid examined. This is easily done when the line in question has been identified by means of Kirchhoff's chart so that its wave-length is known. It will, of course, often happen that no line in the comparison-liquid exactly corresponds with the line D selected for the liquid examined. In this case the index of the nearest line may be employed instead, when great accuracy is not required and when subsidiary prisms are used, or we may use a filar

micrometer, and interpolate so as to obtain the index of a coincident line by measuring the distance of the relative line *D* from one or more visible lines in the comparison-spectrum. The eye-piece micrometer suggested by Professor Rood * would also give all necessary precision, and would have the advantage of being very much cheaper than a filar micrometer.

The method above given enables us to determine the index of refraction of a single line only, unless the prism is emptied, cleaned, dried, and the operation then repeated with a second selected line. To obviate this difficulty, I have employed the following modification of the prism with entire success. The prism is divided into two by a septum perpendicular to its refracting edge. Each prism thus formed has an opening in its base by which liquid may be introduced or removed, and which can be closed with a cork. When the two glass plates are carefully cemented to the brass frame, the two prisms will have the same refracting angle. One of them is then to be filled with the comparison-liquid, the other with the liquid the indices of which are to be determined. The double prism being now placed upon the stage of the spectroscope, one face of the prism containing the comparison-liquid is to be covered with a slip of metal. The spectrum of the liquid to be examined will then be seen by means of the observing telescope. Any line — as, for instance, *C* — may then be selected, brought into the position of minimum deviation, and the telescope adjusted until this line bisects the space between the parallel wires in the plane of the diaphragm of the eye-piece. The telescope is then to be clamped as before without disturbing the adjustment. If now one face of the prism containing the liquid examined be covered with the slip of metal removed from the face of the other prism, the spectrum of the comparison-liquid will be seen, and it will be easy to determine what line in this spectrum most nearly corresponds in position to the line *C* of the other spectrum. By alternately covering the faces of the two prisms with the metal slip, coincidences or near coincidences may be observed for *D*, *E*, *F*, &c.; and in this manner the data obtained for the constants in Cauchy's dispersion-formula for the liquid examined, in a short time and with great facility. It must be borne in mind that the two spectra in this process cannot be seen simultaneously, their images being combined by the observing telescope into one.†

* Am. Journal, 3d series, vol. vi. p. 44.

† Mr. S. P. Sharples has suggested to me that if a cylindrical lens were employed as the object-glass of the observing telescope, the two spectra could be seen in the field at the same time.

In applying the above methods, I have used prisms with brass frames, and have cemented the glass-plates either with common or with marine glue, the latter being employed for aqueous solutions. Good workmanship would doubtless make it possible to fit the plates to the sides of the prisms so that they could be held in their places by springs, the prisms being perfectly tight; but I have not found this to be the case with prisms from German workshops which I have examined.

The process which I have given above furnishes, of course, a new application of the spectroscope to quantitative chemical analysis, — all the results obtained by Landolt with the spectrometer being obtained with the spectroscope alone; but it is hardly necessary to say that a good spectrometer is an instrument greatly to be preferred, since it may be used also as a spectroscope, and since direct methods are always better than those of comparison.

XVII.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

E. C. PICKERING, PROFESSOR OF PHYSICS.

III.—INTENSITY OF TWILIGHT.

BY CHARLES H. WILLIAMS.

Read, May 11, 1875.

DURING the fall and winter of 1874 an attempt was made to measure the amount of light given by the sun when at different distances below the horizon. Days were chosen when the sky was perfectly clear at sunset, though a few observations were made when it was snowy or cloudy.

The instrument used was the photometer first described in the report of the Total Eclipse Expedition for 1870. It consisted of a box about five feet long, eighteen inches high, and twelve inches wide; over the top and sides, which were of light framework, black cloth was stretched; a circular hole, about five inches in diameter, was cut in one end and covered by a Bunsen disk, and a standard candle, in a spring candlestick, was moved along the centre of the box by means of a rod attached to it; the distance from candle to disk being varied at pleasure, and measured by a mms. scale attached to the rod.

It was found inconvenient in practice to be obliged to read the scale at every observation, and the disappearance of the spot could be better watched if the eyes were kept fixed on the disk. An arrangement for automatic registering was therefore added. A piece of sheet-iron connected the candlestick with a rod moving outside the box along its whole length, the iron clasped the rod and was held in place by friction; to the iron was fixed a movable point, which could be pressed into a fillet of paper by means of a string passing from the iron round a pulley at each end of the box. The position of the candle was varied by moving the rod; the point where the observation was taken was marked on the paper, and the distance of the candle from the disk in mms. was read off afterward from a scale.

To use the instrument, a suitable day being taken, the disk was exposed to the horizon a few minutes before sunset, the candle lighted, and placed at about fifty mms. from it. The disk was then watched until it became dark-centred; the distance of the candle from the disk was now adjusted, so that the centre of the disk should nearly disappear, when the time was noted, and observations were then taken every minute till the light became very feeble. It was found impossible to get a perfect disappearance of the spot, owing principally to the difference in color of the two lights, the candle being much more yellow than the sun; a certain neutral shade between the dark and light centre was therefore taken as the point for making the observations. Various attempts were made to get rid of this difference of color, but without success. A cell filled with a solution of sulphate of copper of different strengths was placed on the candle side of the disk, also indigo and other blue solutions; the only effect of these was to give the whole surface of the paper a greenish tint when the candle was brought near, without making the disappearance of the spot more perfect. Disks made of paper of different colors, and sheets of plaster of Paris, made extremely thin by pressing the fluid plaster between sheets of plate glass, were tried with the same results. The best material seemed to be fine white paper painted with spermaceti, except at the centre.

It seemed to make no difference in the relative diminution of the light, whether the observations were taken with a clear horizon or with part cut off by some adjoining building; the readings from the upper part of the building looking over the roofs agreeing very well with those taken below. Having made a number of observations on different days, the instrument was tested to get the probable error of any reading. The photometer was placed in a dark room and a fixed amount of daylight admitted, the candle was moved till the disk

TABLE I.

Distance.	Prob. E.	Percentage.
130 mm.	2. mm.	3
175 „	2.9 „	3
240 „	2.5 „	2
440 „	9.5 „	4
455 „	4.1 „	2
520 „	10. „	4
635 „	8.2 „	3
950 „	8.9 „	2

assumed the neutral tint, and the mean of ten readings taken. The amount of light admitted to the room was then increased, and eight sets of readings thus taken. The preceding table gives, in the first column, the mean distance of the candle from the disk for each series of ten settings; in the second, the probable error for each reading; and in the third, the percentage of error.

It will be seen that the probable error is not large enough to seriously invalidate the results of the observations, as the readings taken by the photometer denoted the distance at which a standard candle should be held from the disk to give a light equal to that from the sun at a given time; it was thought best to reduce those readings to some standard, and compare them with the light given by a standard candle burning at a distance of one metre from the disk. Suppose we wish to reduce a reading of 200 mms. to this standard, C, or 1,000 mms. Let $I =$ actual intensity: —

$$C : I = 200^2 : 1000^2 = \frac{1}{1000^2} : \frac{1}{200^2};$$

whence $$I = C \left(\frac{1000}{200}\right) 2 = 25\, C.$$

In this way Table II. was constructed, giving the actual amount of light, the readings being taken every minute.

On the days represented in the first six columns, the observations were all taken with an unobstructed horizon. On Nov. 6 and 7, part of the sky was shut off by surrounding buildings. Jan. 15, there were a few clouds; and Jan. 3, the whole sky was overcast. Nov. 13, a cell with sulphate of copper solution was placed behind the disk; and on Dec. 31, a cell with solution of indigo was used.

To see whether the light decreased according to any function of the time, curves were constructed, taking for vertical distances the logarithm of the observed reading, and for horizontal distances the minutes after sunset at which the observations were made. The result gave a series of nearly straight lines all running in the same direction. In some of the lines, there was a decided bend in the middle, and traces of this were found in almost all. To make this bending more apparent, a residual curve was constructed; this was obtained by comparing each of the curves with a straight line drawn in their mean direction, and making the ordinates of the desired curve the mean of their differences from this straight line. In this way the deviation of the original curves from the straight line was made quite apparent, though the difference was not originally very great. To find the curve which should represent the diminution of the light for each minute after sun-

TABLE II.

Min'tes after Sunset.	Nov. 12.	Nov. 13.	Dec. 31.	Jan. 1.	Dec. 15.	Dec. 21.	Nov. 6.	Nov. 7.	Jan. 15.	Jan. 3.
1							237	177	27	7
2							204	149	25	6
3							204	135	21	6
4							188	114	19	5
5							177	108	16	4
6							149	98	13	4
7							139	91	12	3
8				164			132	81	10	3
9				144		156	121	74	9	2
10			174	125		141	114	64	7	2
11			161	121		134	100	54	6	1
12			144	106		125	89	43	5	1
13			141	104		118	81	37	4	
14			130	94		102	74	31	3	
15			102	77		83	63	26	3	
16	139		84	76		72	59	24	2	
17	132		76	63		59	48	20		
18	108	119	66	52		52	44	18		
19	98	96	?	41	46	45	34	15		
20	77	96	45	35	45	41	27	11		
21	69	69	35	32	39	35	23	10		
22	51	49	30	26	30	29	18	8		
23	46	?	23	23	26	25	15	6		
24	38	33	20	18	23	23	12	5		
25	31	30	17	15	19	20	10	4		
26	22	24	14	14	15	18	7	3		
27	16	20	11	10	11	14	4	3		
28	?	15	8	9	9	11	3	2		
29	13	12	?	7	8	10	3	2		
30	11	9	6	7	6	7	2	2		
31	9	7		5	5	7	2	1		
32	8	6		4	4	6	1	1		
33	6	5		4	?	5	1	.9		
34	4	4		3	3	4	1	.8		
35	?	3		2		3	.9	.6		
36	3	2		2		3	.7			
37	3	2					.7			
38	3	2								

set, the ordinates of the straight line were obtained, to these were added the ordinates of the residual curve for the same times after sunset, both readings being in logarithms of the original observations; this logarithmic sum was now doubled, the sign changed, and the figures so obtained were used as ordinates for a new curve, the abscissas being the times. From this last curve we obtain directly the logarithm of the number which would represent the proportion of light at any minute as compared with that at sunset, which we call unity.

In the following table the minutes after sunset, or abscissas, and the percentage of light as compared with sunset, or ordinates, are given, from which the last curve was constructed: —

TABLE III.

Minutes after Sunset.	Per cent of Light compared with Sunset.	Minutes after Sunset.	Per cent of Light.
0	1.000	18	.094
1	.950	19	.079
2	.817	20	.064
3	.752	21	.055
4	.655	22	.044
5	.597	23	.038
6	.516	24	.031
7	.466	25	.026
8	.407	26	.021
9	.337	27	.015
10	.290	28	.012
11	.261	29	.010
12	.228	30	.009
13	.200	31	.007
14	.177	32	.006
15	.143	33	.005
16	.128	34	.004
17	.101		

IV.—LIGHT OF THE SKY.

By W. O. Crosby.

The light of the sky is reflected light, of which the sun is the source.

It is well known that the light of the sky diminishes as the angular distance from the sun increases. And the following observations were made with a view, first, to determine the absolute amount of light received from the sky at different distances from the sun; secondly, to ascertain the law of the diminution of the light with increasing angular distance from the sun. The apparatus employed consisted of a common mirror, so arranged as to reflect the light horizontally into a darkened room, a condensing lens having an aperture of 9 cm. and a focal distance of 225 cm., and a photometer similar to that employed by Dr. Williams in his observations on twilight.

The method pursued was to so adjust the mirror and lens that an image of the sun would fall upon the disk of the photometer, and then

to measure the intensity of the light at regular intervals of time as the sun receded from the portion of sky from which the light was received.

By allowing the mirror to remain fixed during an entire series of observations, absolute uniformity in the angle of incidence of the light on the mirror was obtained, and thus the percentage of the light reflected by the miror rendered constant, and exact measurements of the angular distance from the sun could be easily made by simply noting the lapse of time.

One result of this method is that all the observations are made east of the sun; the part of the sky from which the light is received being necessarily on the sun's path. A reverse series can be readily obtained on the west side of the sun, by adjusting the mirror so as to receive light from a point at a convenient distance west of the sun, on the path of the same, and then making observations at regular intervals as the sun approaches the point.

The light was received from a circular sky area, 2° 20′ in diameter, or 4.25 square degrees; and the proportion of the light lost by reflection from the mirror, and transmission through the lens, was about .40 of the whole. The following table embraces the results of four series of observations. Column one gives the angular distance from the sun. The second, third, fourth, and fifth columns give the intensity of the light received from one square degree of sky; the unit of intensity being the light of a standard candle at a distance of one metre. Series I. was made Jan. 20, 1875, between the hours of 2.45 and 3.47 P.M., beginning 15° 45′ west of the sun. The declination of the sun at this time was 20°; and, since the angles given in the table for this series were not measured on a great circle, they should be reduced in the proportion of the radius to the cosine of the declination. Series II., III., and IV. were made east of the sun between 12 M. and 1 P.M.; the II. on March 23, the III. and IV. on March 27.

On Jan. 20, the sky was hazy, had a whitish-gray aspect, and reflected much light; on the 23d of March it was clear and blue; and on the 27th very clear, reflecting but little light. The great difference in the intensity of the light on these different days is well shown by comparing columns two, three, four, and five of the table.

The meteorological importance of such observations as these is suggested by the fact that it is commonly believed that a deep blue sky, reflecting little light, indicates the presence of a large amount of the vapor of water in the atmosphere, and the probable approach of rain, and that a very clear night frequently precedes a rainy day. If

it can be proved that such a relation exists between the relative moisture of the upper atmosphere and the light of the sky, it is evident that we have here a hygrometer with a widely extended range.

Sun's Dist.	I.	II.	III.	IV.	1.	2.	8.	4.	Mean.
0°20′		28.70	12.61	9.41		— 8.8	+ 5.5	—19.0	— 0.1
0 45	75.80	17.41	6.75	7.28	—15.2	+ 8.0	— 5.2	+ 6 4	+ 1.4
1		18.71	5.15	4.61		+22.0	+ 6.7	— 5.2	+ 7.8
1 15	61.16	7.88	8.83	8.53	— 4.8	— 4.3	+ 4.7	— 6.4	— 2.0
1 80		5.68		8.00		—12.5		— 0.0	— 6 2
1 45	47.33	4.70	2.53	2.37	— 1.8	— 8.2	+ 9.0	— 4.5	— 1.2
2		4.28	1.87	1.78		+ 1.9	— 4.0	—25.3	— 9 1
2 15	40.00	8.45	1.58	1.51	— 8.8	— 8.3	— 5.5	—21.7	— 8.4
2 80		2.87		1.87		— 6 4		—16.5	—11.4
2 45	84.26	2.41	1.15	1.23	+11.2	—10.2	—10.4	—15.0	— 6.1
8 15	27.16	2.05	1.01	1.07	+10.5	— 1.7	— 1.9	— 9.6	— 0.6
8 45	20 00	1.61	.88	.98	— 1.0	— 5.7	— 2.1	+ 0.0	— 2.2
4 15	17.66	1.50	.75	.88	— 2.4	+ 6.0	+ 4.8	+ 4.7	+ 8.1
4 45	14.75	1.88	.65	.83	+ 1.0	+ 9.7	+ 4.3	+12.3	+ 6.8
5 15	18.50	1.17	.60		+ 6.4	+11.5	+ 9.7		+ 9 2
5 45	11.83	1.10	.55	.72	+ 1.9	+18.6	+13.3	+23.1	+14.2
6 15	9.50				— 4.7				— 4.7
6 45	8 48			.60	— 5.2			+24.5	— 1.4
7 15	6.80			.56	—19.4			+26.8	+ 3 7
7 45	6.58			.52	—12.3			+29.0	+ 8.4
8 15	6.21				— 9 0				— 9.0
8 45	5.45				—13 8				—13.8
9 15	5.13				—12.3				—12.3
9 45	4.98				— 8.0				— 8.0
10 15	4.70				— 6.2				— 6.2
10 45	4.93				+ 5.7				+ 5.7
11 15	4.60				+ 4.7				+ 4.7
11 45	4.80				+ 1.6				+ 1.6
12 15	4.15				+ 6.4				+ 6.4
12 45	8 90				+ 6.5				+ 0 5
13 15	8.71				+ 6.7				+ 6.7
13 45	8.47				+ 4.5				+ 4.5
14 15	3.10				— 1.4				— 1.4
14 45	2.90				— 4.0				— 4.0
15 15	2.80				— 8.0				— 3.0
15 45	2.71				— 1.4				— 1.4

A curve has been constructed for each series of observations, having intensities as ordinates and natural sines of the sun's angular distances as abscissas; and an inspection of these curves shows a close agreement in their forms, which indicates that, notwithstanding the great differences in the intensity of the light, its variations followed the same, or nearly the same law, in each case. Other curves were constructed, with co-ordinates equal to the logarithms of the co-ordinates of the curves just mentioned, which show by their approximation to straight lines that the law of the variation of the light may be expressed by

the equation $y = mx^n$, the light being proportional to some power of the sun's angular distance.

The most noticeable deviation from a straight line is in the curve for series I. where it approaches the axis of y; here the intensities are less than required by a straight line, which is explained by the fact that this series was made late in the afternoon of a winter day when the light of the sun itself was rapidly diminishing, and, as before stated, the observations nearest the sun were made last.

Neglecting, for the reason just given, the first three observations of series I., we obtain the following as the most probable values of n in each case: series I. — 1.4; II. — 1.4; III. — 1.32; IV. — 1.21. Computing now the numerical value of m for each series, and substituting in the equation $y = mx^n$, we have for series: I. $y = 359x^{-1.4}$; II. $y = 33.1x^{-1.4}$; III. $y = 13.7x^{-1.32}$; IV. $y = 12.6x^{-1.21}$.

Columns 1, 2, 3, and 4 give the deviations from the formulæ of the observations of series I., II., III., and IV. respectively; the deviations being expressed in percentages of the intensities. The last column gives the mean of the deviations; neglecting, as before, the first three observations of series I. Although some of the deviations are quite large, yet the sums of the positive and negative deviations are approximately equal; and it will be observed that they frequently change their sign, which shows a close agreement with theory. It is probable that the larger deviations are attributable in part, at least, to sudden changes in the reflecting power of the sky, such as would be produced by air currents or by the precipitation or dissipation of atmospheric moisture.

That these deviations are greater than those due to errors of observation, is clearly shown by the experiments in the preceding article.

V. — LIGHT ABSORBED BY THE ATMOSPHERE OF THE SUN.

By E. C. Pickering and D. P. Strange.

The following series of experiments were made for the purpose of determining the relative amount of light received from portions of the sun's surface at varying distances from the centre of its disk. For this purpose, the sun's rays were reflected into a darkened room by means of the black glass mirror of a porte-lumière, and an image of the sun, 40 cms. in diameter, was, by means of a small telescope, thrown upon a screen placed at a distance of 230 cms. from the aperture. In the

centre of this screen was cut a circular hole 2 cms. in diameter, and the light passing through this aperture was received upon a Bunsen's photometer disk, placed at a distance of 25 cms. behind it. The porte-lumière was then moved until the desired portion of the image coincided with the centre of the aperture in the screen, and the image kept at rest by a slight movement of the telescope whilst the photometer reading was taken. The light used for comparison was a standard candle, which was placed in the photometer described above (page 421). Much difficulty was experienced on account of the difference in color of the light from the sun and candle, in obtaining a satisfactory disappearance of the spot of the photometer disk. Various attempts were made to remedy this trouble, by using colored paper, disks of colored plaster, &c., none of which succeeded very well, and the ordinary white disk was finally adopted. A large number of preliminary series of observations were made, and rejected as not being sufficiently accurate.

The results of the last three days' observations are given in Table I.; the first column giving the percentage distance from the centre

TABLE I.

	1st D.	2d D.	3d D.	E.	P.	M.	P. Er.	Theor.	Diff.
0.0	100.0	100.0	100.0	100.0	100.0	100.0	0 0	100.0	0.0
12.5	98.5	98.9	99.1	99 0	98.9	98.9	0.1	99.4	−0.5
25.	94.3	97.5	94.4	97.2	97.0	96.7	0.4	97.9	−1.2
37.5	93.9	94.7	91.0	93.7	93.1	94.2	0.3	95.0	−0.8
50.	90.9	91.7	88.6	90.8	89.5	91.3	0.3	91.0	+0 3
62.5	84.4	86.9	79.7	87.3	83.8	86 2	0.7	85.0	+1.2
75.	80.5	78.9	76.0	80.5	76.0	78.8	0.7	77.2	+1.6
85.	69.1	69.5	66.5	71.4	66.3	69.2	0.8	68.4	+0.8
95.	62.9	53.6	57.9	56.1	52.8	55 4	1.6	54.8	+0.6
100.	....	....	37.4	....	....	37.4	0.9	37.4	0.0

towards the edge, and the succeeding ones the intensity of the light compared with that of the centre taken as unity. The second column gives the mean of the first day's, the third of the second day's, and the fourth of the third day's observations. Upon the second day, there were several times as many observations taken as upon either of the others, and its mean is correspondingly more reliable. A portion of the observations were taken upon or near the polar, and others upon or near the equatorial, diameter of the sun. Column 5 gives the mean of the measurements taken upon the equatorial, and number 6 the mean upon the polar, diameter. As these are the results of but a

comparatively small number of observations, it seems difficult to decide whether the apparently greater brilliancy towards the edge along the equatorial diameter is real, or is due to errors of observation. Column 7 gives the mean of all the measurements taken, and column 8 the probable error of this mean.

If the sun had no atmosphere, its disk as seen from a distance would appear uniformly bright, since the light emitted by one square metre in any given direction is inversely as the cosine of the angle of emission, while, owing to foreshortening, its apparent area is proportional to the cosine of the same angle. Let us next suppose it surrounded by a homogeneous atmosphere not perfectly transparent. Evidently the absorption will depend on the distance which the light has to pass through it, and will be greatest at the edges, and least at the centre; or the disk will appear brightest at the centre and darkest at the exterior, as is actually the case. To determine the law of this variation, let the radius of the disk equal unity, x the apparent distance of any point from the centre, h the height of the atmosphere, b the brightness of any portion of the disk were there no atmosphere, a the proportion of light which would traverse a thickness of the atmosphere equal to unity, or to the sun's radius. Call v also the distance the light from the point x must traverse before emerging from the solar atmosphere, and y the apparent brightness of the same point. It is readily proved that $v = \sqrt{(1+h)^2 - x^2} - \sqrt{1-x^2}$, and that $y = ba^v$; therefore,

$$y = ba^{\sqrt{(1+h)^2 - x^2} - \sqrt{1-x^2}}$$

is the equation which gives the brightness of any point of the sun's disk, assuming that its atmosphere is homogeneous. From any three corresponding values of x and y we can compute a, b, and h. Assuming from the above observations $y = 1$ for $x = 0$, $y = .782$ for $x = .75$, and $y = .374$ for $x = 1$, and taking logarithms, we deduce the three equations of conditions: —

$$0 = \log b + h \log a;$$
$$-.1068 = \log b + (\sqrt{(1+h)^2 - .5625} - .6614) \log a;$$
$$-.4271 = \log b + (\sqrt{2h + h^2}) \log a.$$

Subtracting these equations, we eliminate b; and dividing one of the resultant equations by the other, eliminates a. We thus deduce the equation: —

$$\sqrt{.4375 + 2h + h^2} - .25\sqrt{2h + h^2} - .75h - .6614 = 0.$$

To solve this equation, its first member was placed equal to m, and various values of h substituted; a curve was then constructed with m and h as coördinates, and a few trials readily gave the value of h corresponding to $m = 0$. This affords an easy means of solving many equations not readily treated by the usual methods. The value of h thus found was a little less than unity. Substituting $h = 1$ gives $\log a = -.5835$, $a = .2609$, $\log b = .5835$, and $b = 3.833$. Or, if the effect of the solar atmosphere resembles that of a homogeneous atmosphere, its height must equal the radius of the sun, and its opacity be such that the light in the centre is only .26 of what it would be were the atmosphere removed; or the sun's brightness in the latter case would be throughout 3.8 times its present brightness at the centre. Substituting these values of a, b, and h in our first equation, gives

$$\log y = .5835 - .5835\,(\sqrt{4 - x^2} - \sqrt{1 - x^2}),$$

in which, by substituting various values of x, we deduce the corresponding values of y, the light at various points of the sun's disk. In Table I., the column headed Theor. gives the amount of light computed by this formula, and the last column the differences from the mean observations, M. Three other theoretical values were computed for these points, but those given in the table were retained as agreeing most nearly with observation. From these it appeared that a considerable variation in h did not alter the amount of light very materially, that a diminutive change of h of one-tenth increased the light between $x = .6$ and $x = .9$ only half a per cent, and for other values of x altered y still less. Moreover, the differences in the last column of the table are evidently too regular to be due to accidental error, but rather show a real variation from theory, due to the fact that the atmosphere is not really homogeneous. We might assume that the law of the density is the same as that of the earth's atmosphere, or that, the height being taken in arithmetical progression, the densities will vary geometrically. But this leads to an equation which cannot be integrated, and, moreover, cannot be correct in fact, since it assumes that the temperature is uniform throughout. The great heat near the surface, by expanding the atmosphere in contact with it, diminishes its density, thus rendering it more nearly homogeneous than the above law would require; this effect is, however, counteracted by the tendency of the heavier gases to descend.

It is a matter of interest to know not merely how much light is cut off by the atmosphere at the centre of the sun's disk, but also how much the whole light of the sun will be reduced by the same cause.

Suppose the curve constructed with coördinates equal to x and y of the preceding table, and that a solid of revolution is generated by revolving it around the axis of Y: evidently, the volume of this solid will represent the total amount of light received by the observer from the whole of the sun's disk, and the volume of the circumscribing cylinder will equal that which would be received if the disk throughout had the same brightness as at the centre. The ratio of these two quantities is, however, obtainable by Simpson's formula, and gives the result 82.6, or the light is about five-sixths of what it would be if the disk had the same brightness at the edges as at the centre. Now, as shown above, the light at the centre is reduced by the atmosphere to 26.1 per cent. Hence the total reduction of the whole surface is $.261 \times .826 = .216$. And, since the light is reduced in every direction by the same amount, we may say that the sun would give out 4.64 times as much light if its atmosphere were removed.

The results of this paper may therefore be summed up as follows. The light of the various parts of the sun's disk is measured by the modification of the Bunsen photometer here employed, and given in the accompanying table, with a probable error not exceeding one per cent except close to the edge. The light at the edge is about .4 of that at the centre. The variations in brightness are nearly those which would be produced by a homogeneous atmosphere of height equal to the sun's radius, and opacity such that only 26 per cent of the light is transmitted. There appears to be a slightly different distribution of the light along the polar, from that along the equatorial, diameter. If the atmosphere were removed, the brightness of the sun's disk would be uniform, and 3.83 times that of the centre of the disk at present. Moreover, the total amount of light would be increased 4.64 times.

VI. — TESTS OF A MAGNETO-ELECTRIC MACHINE.

By E. C. Pickering and D. P. Strange.

The rapidly increasing use of magneto-electric machines as a source of electricity renders accurate tests of the comparative advantages of the various forms and exact measurements of the currents generated under varying conditions very desirable. The machine employed in the following experiments was made by Mr. M. G. Farmer, and consists of a large electro-magnet wound with four coils soldered together

at the ends, like four battery cells connected for quantity. Between the poles of this magnet a Siemens' armature is revolved, and both magnet and armature are included in the main circuit. The instrument is therefore extremely simple, and, when the circuit is broken, requires no power to run it except to overcome the friction of the bearings. The total weight is about 700 lbs., and the dimensions 33.5 by 21.5 inches (85 $\times$ 55 cms.), with a height of 14 inches (37 cms.). To avoid heating, a water space is left close to the armature, but this is required only when the resistance of the circuit is small.

The quantities to be measured were as follows: 1st, velocity of rotation of armature; 2d, power required; 3d, strength of current with various speeds and resistances; 4th, electro-motive force under the same conditions; 5th, when the current is used to produce a light, a measure of the latter is candle-power.

Power. The boilers and engine of the Institute were used as a source of power. The nominal capacity of the boilers was sixty-six, and of the engine fifteen horse-power; but, owing to various difficulties beyond the control of the writers, only a small portion of this was available, and that only for limited periods of time. A belt passed from the fly-wheel of the engine over a countershaft in the Physical Laboratory, giving it a velocity of about 500 turns per minute. A set of five cone pulleys were attached, by which a speed of 333, 410, 500, 610, and 750 turns could, by shifting a belt, be given to a second shaft. The latter carried a wheel 20 inches in diameter, and drove the machine by a belt passing over a pulley 8 inches in diameter attached to the armature. As the speed of the engine varied somewhat, a speed of from 800 to 2100 turns per minute was thus obtained. Various plans were tried to measure the power employed. For the earlier experiments a Batchelder dynamometer was used, in which the motion was transmitted through four bevel-gears, and the moment of tension measured by a spring-balance and weights. The instrument was not however intended to be run at such high speeds, and the gears were very noisy.

Speed. The number of revolutions per minute is so important a factor in these measurements that it must be constantly determined. At first, a common shaft speeder was employed; but, apart from its want of accuracy, its constant use was laborious, and it showed only the total number of turns during a minute, and not the speed at any intermediate instant. A device was accordingly employed, constructed by Mr. J. B. Henck, Jr., by which these difficulties are completely avoided. The plan is not new, having been published in a modified

form many years ago in Nicholson's Mechanics and elsewhere. Three vertical gas-pipes are placed side by side, and connected together below; then half filled with mercury, and so mounted that they may revolve around the axis of the central pipe; a glass tube filled with water is attached to the latter, and serves to show the position of the mercury. Motion was transmitted to the whole from the horizontal shaft of the machine by a spiral spring, as in a dental lathe, but afterwards this was replaced by a pair of bevel-gears. If now the machine is set in motion, the mercury is by centrifugal force thrown from the central to the outer tubes, and the water in the glass tube falls. A graduated scale shows the position of the water, which remains very constant as long as the velocity is uniform, and by its motion shows the slightest variation in speed. The reduction is effected by noting the water level with various velocities as measured by a shaft-speeder, and constructing a curve with coördinates equal to these two quantities. If the tubes are exactly parallel and of uniform diameter, this curve will be a parabola, with axis vertical and parameter determined by the equation $y = 473 \times 10^{-6} n^2 d^2$, in which d is the distance of the outer tubes from the centre in inches, and n the number of turns per second. Evidently an inch would correspond to a much greater change in velocity at high than at low speeds, and accordingly the open ends of the outer tubes were bent in towards the centre. This had the additional advantage of preventing the mercury from being thrown out, and of greatly increasing the range of the instrument. As actually constructed, the speed in turns per minute very nearly equalled the square of the depression of the water level in tenths of an inch.

Resistances. A difficulty at once presented itself in varying the resistance of the circuit, since resistance coils of the ordinary form would be at once injured or even melted by the immense quantity of electricity transmitted. Accordingly a set of resistances were prepared by stretching some uncovered German silver wire along the wall of the laboratory, so as to form nine loops, of eighty feet each, of No. 28 wire. As the diameter is .017 inches, the surface exposed to radiation is about 460 square inches; and, as the air circulates freely around them, there is no difficulty from their heating, even when the machine is connected directly with their terminals. Each of these loops has a resistance of 36.9 ohms, and one or more may be thrown into circuit by a switch. For smaller resistances, a similar device was employed. A frame, 3 feet wide and 6 feet high, was covered on both sides with horizontal wires, passing around screws so as to form 30 loops of No. 22 wire (diameter .029″) and 55 loops of No. 16 wire

(diameter .065″). The former had a total resistance of 29.68 ohms, the latter of 9.18 ohms, or the single loops .99 and .167 ohms. To allow for accidental variations in the wire or in the connection, each loop was measured separately, and a table of resistances thus formed. To the end of each loop was attached a short piece of stout copper wire, wound in a helix and sunk in a hole, so that any two could be connected by a wire terminating in copper plugs. By this system, any resistance from .17 ohms to 370 ohms was easily thrown into the circuit, and the connections were few in number and of very small resistance. This plan also had the advantage of extreme cheapness. The heating of the wire was independent of its length, except so far as the current altered. Practically, the three sizes of wire employed would convey 1.5, 5, and 10 vebers, without undue heating. A change of temperature of 100° C. increases the resistance of German silver wire about 4 per cent; and, to allow for this, a so-called thermometer-board was employed, on which pieces of the three wires wound in a helix were stretched. To determine the heating of either size of wire, the proper helix was inserted in the circuit, and a thermometer placed in it. On trial, it was found that the readings were much too high, the radiation prevented by the adjacent spires of the helix much more than compensating for the imperfect connection with the thermometer. This difficulty might be avoided by stretching the helix until these two errors should compensate, which might be tested by covering the helix and a straight wire with iodide of mercury and copper, and altering the form until the color of the iodide changed with the same current in both. As, however, the correction is small at ordinary temperatures, it was deemed best to neglect it, taking care to touch them occasionally when very powerful currents were passing, to make sure that the wires did not become very hot.

Current. A special device is also needed for the determination of the current produced in absolute measure. If an ordinary tangent galvanometer with a single coil of thick wire was employed, the stronger currents could be well compared; but it would be difficult to reduce them to vebers, since a feeble current suitable for depositing copper would not appreciably deflect the needle. Accordingly, a cosine galvanometer shunted was employed, or rather, as here used, a tangent galvanometer, since the coils were kept vertical. The coils consisted of about 50 turns of No. 16 copper wire, 6 inches in diameter, and 3 inches apart. The needle had a length of but $\frac{3}{8}$′, and was made of a piece of watch-spring. An index, 3 inches long, was attached; and the magnet, being suspended by a filament of silk, swung over a gradu-

ated circle divided into degrees, and the fractions estimated to tenths by the eye. To eliminate parallax, the bottom of the compass-box was formed of looking-glass, and the eye so placed, when the reading was taken, that the index and its reflection coincided. To determine the constant of the galvanometer, a constant current from a thermal battery was passed through it and through a beaker containing sulphate of copper, and the weight of copper deposited measured. Two determinations were made, and gave the result .052. To make sure that the galvanometer followed the law of the tangents, a series of resistances were interposed in the circuit, and the deflection measured. The results showed that the error was extremely small, even for angles as large as 80° to 85°. The resistance of the galvanometer was .22 ohms, and by it, currents from .02 to .3 vebers could be well measured. For stronger currents a set of shunts were prepared. The wires from the galvanometer were carried parallel to each other and near together for some distance to avoid their disturbing action on the needle, and the resistance thus increased to exactly .25 ohms. Three shunts, *A*, *B*, and *C*, were then prepared, which should reduce the current to .2, .04, and .014, consisting of short stout pieces of German silver wire. The first and second of these were easily made by computing their required resistance, and sliding them in or out of the screw cups in which they were held. They were then tested by passing the same current first through the galvanometer with and without the shunt, and comparing the tangents of the deflections in the two cases. To correct for the change in resistance, an additional resistance was inserted when the galvanometer was shunted. The third shunt could not be made directly, as its resistance was only .0034 ohms, and we could measure directly, only to thousandths of an ohm. The method of comparison alone was therefore used, reading the deflection when the whole current of the machine was passing, and again using the $\frac{1}{25}$ shunt. The correct values of the three shunts were thus found to be .1980, .0392, and .0137. The latter consisted of a bar of German silver, .13″ in diameter and 3″ long. To pass from one shunt to another, a simple switch or plug could not be employed, since the resistance of the shunts *B* and *C* was so small that the variable resistance thus introduced would become quite perceptible, being multiplied many times; and, moreover, with the stronger currents, the points of contact might become heated or burnt. Accordingly, a switch was inserted in the wire connected with one terminal of the galvanometer, by which it could be connected with either of the three shunts, and a second connection made with each, and with the main circuit. The

other terminals of the machine and galvanometer were permanently connected with the other ends of the three shunts.

Another and better method, both as requiring no very small resistances and as employing but a single switch connection, is the following. Call G the resistance of the galvanometer, connect a resistance r' to one of its terminals, and shunt by a second resistance s'. Attach to one end of this a coil r'', and shunt again by the coil s''. If necessary, shunt again until a sufficient reduction is attained. Now connect one terminal of the machine with one end of G, s', and s'', and bring the other in contact with the other end of either of them by a simple switch, and we shall have the effect of three shunts of three different sensibilities. The total resistance and the relative constants may be computed in each case, or they may be measured directly. Calling the total resistances R_1, R_2, and R_3, and the shunts to which they are equivalent S_1, S_2, S_3, we may deduce proper values by the usual formulas for divided currents. As, however, the case is a little complex, it is best to reduce it to the following symmetrical form: Let $f(x, y, z) = xy + xz + yz$; then we have:—

$$R_1 = G\,\frac{f(r', s', s'' + r'')}{f(G + r', s', s'' + r'')} \qquad S_1 = \frac{f(r', s', s'' + r'')}{f(G + r', s', s'' + r'')}$$

$$R_2 = \frac{(G + r')\,s'\,(s'' + r'')}{f(G + r', s', s'' + r'')} \qquad S_2 = \frac{s'\,(s'' + r'')}{f(G + r', s', s'' + r'')}$$

$$R_3 = S\,\frac{f(G + r', s', r'')}{f(G + r', s', s'' + r'')} \qquad S_3 = \frac{s'\,s''}{f(G + r', s', s'' + r'')}.$$

In these equations, G would generally be given; and we may, theoretically at least, assume any five other quantities, and then deduce the remainder. As, however, these equations are too complex to be used with any convenience, let us see how they may be simplified. Suppose that $s' = s'' = G$, and that $r' = r'' = nG$, then our six equations become:—

$$R_1 = G\,\frac{1 + 3n + n^2}{3 + 4n + n^2} \qquad S_1 = \frac{1 + 3n + n^2}{3 + 4n + n^2}$$

$$R_2 = G\,\frac{1 + 2n + n^2}{3 + 4n + n^2} \qquad S_2 = \frac{1 + n}{3 + 4n + n^2}$$

$$R_3 = G\,\frac{1 + 3n + n^2}{3 + 4n + n^2} \qquad S_3 = \frac{1}{1 + 3n + n^2}.$$

If now $n = 1$, or all the resistances equal G, the three values of R become .625, .5, and .625; while those of S are .625, .25, and .2. If $n = 2$, R becomes .733 G, .6 G, and, .733 G, S_1 .733, .2, and .091; $n = 5$

gives R_1 .853 G, .75 G, and .853 G, and S .853, .125, and .0244. Finally $n = 10$ gives R_1 .916 G, .846 G, and .916 G; and C_1 .916, .076, .0073. It will be more convenient in general to give r', r'', s', s'', approximately the proper values, and then measure R_1, R_2, and R_3 by the Wheatstone's bridge. Next interpose resistances in the wires attached to the switch, so as to make the total resistance of the galvanometer the same for all positions of the switch. Thus, in the above example, when $n = 10$, if resistances of .084, .154, and .084 ohms are interposed, the galvanometer resistance will be an ohm in each case. The values of S_1, S_2, and S_3 are now found directly by comparing the deflections when the switch is moved. By this device, the range of a tangent galvanometer may be increased indefinitely, and the strongest as well as weak currents measured by it. Moreover, the resistance is not altered, so that readings with different shunts are directly comparable.

The first experiments made with the machine were for the purpose of determining whether the current was constant under the same circumstances or not. It was feared that, as the magnetism was induced by the current itself, variations would appear, dependent on the time during which the circuit had been closed; but, on trial, it was found that the magnet attained its full polarity sooner than the needle of the galvanometer came to rest, and that, on making and breaking the circuit, the successive deflections were almost precisely equal. The next problem was to determine the effect upon the current of changing the position of the commutator. This is so made as to be capable of being revolved round the shaft of the Siemens' armature through an angle of about 45°, thus taking off the current when the coil of the armature is in different positions relatively to the electro-magnet. Observations were taken with the commutator in the following eight different positions: No. 1 is with the commutator turned farthest down, or with its plane as nearly parallel with the plane of the electro-magnets as possible. It is then turned up through an angle of about 6.5° with each succeeding number. In No. 8, it is very nearly perpendicular to the plane of the magnets. The results of several experiments are given in Table I., in the 2d, 3d, 4th, and 5th columns, of which the current obtained in the various positions is given in vebers per second. In the last four columns, the currents are given in percentages of the maximum obtained.

TABLE I.

1.	2.	3.	4.	5.	6.	7.	8.	9.
1	.0620	.0962	.0486	.1066	96.6	93.8	93.2	92.5
2	.0625	.0986			97 8	96.1		
3	.0631	.0999	.0450	.1115	98.3	97.4	96.2	96 8
4	.0638	.1010	.0455	.1115	99.4	98.8	97.2	96.8
5	.0641	.1021	.0467	.1146	99.8	99.7	99.8	99.5
6	.0642		.0468	.1152	100.0		100.0	100.0
7	.0640				99.7			
8	.0635		.0466	.1152	98.9		99.6	100.0

It thus appears that the position of the commutator has but little influence upon the strength of the current; but, as the maximum was obtained in each case from position No. 6, it was kept in that place in all further experiments.

Next, to determine the relation between the four variables, speed of revolution, resistance in circuit, current, and electro-motive force. An attempt was also made to measure the work required to run the machine, and the coefficient of efficiency; but, from lack of proper dynamometric facilities, the attempt was necessarily abandoned after the first series of experiments.

The results of these experiments are given in the following tables, in which R is the resistance of the circuit, expressed in ohms; S is the speed, or number of revolutions of the armature per minute; C is the current in vebers per second; E is the electro-motive force in volts; E_1 is the computed electro-motive force in volts, which would have been obtained with a speed of 1,000 revolutions per minute; W is the work expended, in foot-pounds, including friction. $W.C$ is the work the current is capable of doing, in foot-pounds; and $C.E$ is the coefficient of efficiency of the machine, obtained by subtracting the work required to drive the machine on an open circuit from the actual work W, and dividing the computed work $W.C$ by the remainder.

From an examination of these tables, several important conclusions may be drawn. For large resistances, over 38 ohms for instance, the electro-motive force is nearly proportional to the speed, and is given by the equation $E = .007S$. The advantage of placing the magnet in the main circuit is here in a great measure lost, since the large outside resistance so far reduces the current that its effect on the magnet is slight. The constant .007 affords a good means of comparing various machines of this form, since its magnitude depends directly on the arrangement of the magnet and armature. For resistances less than

TABLE II.

R.	S.	C.	E.	E_1.	W.C.	W.	C.E.
264.6	750	.023	6.10	8.13	.104	306	
227.4		.027	6.09	8.11	.121	303	
190.8		.032	6.08	8.11	.148		
153.2		.040	6.08	8.11	.178		
116.0		.052	6.10	8.13	.238		
78.9		.078	6.16	8.22	.335		
52.6		.131	6.38	9.04	.664		
41.7	760	.159	6.67	8.76	.788		
41.5		.162	6.72	9.02	.816	809	
27.6	745	.336	9.28	12.45	2.34	828	
21.8	745	.587	12.79	16.9	5.64		
15.44	740	1.42	21.14	28.5	22.5	550	.096
11.44	730	2.20	25.16	34.5	41.5	697	.105
7.50	725	4.17	31.29	43.1	97.9	955	.146
5.15	725	5.29	27.24	37.5	108.1		
4.44	720	6.82	27.48	38.1	124.9	1274	.122
4.44	580	6.96	30.91	53.3	161.4	984	.228
2.97	425	11.26	33.39	78.5	282.1	952	.362
2.78	590	8.62	23.96	40.6	154.9	1403	.133
2.30		9.71	22.32	39.8	162.4		
1.956	530	10.05	19.66	37.1	148.2		
1.786	310	11.58	20.68	66.7	179.6	735	.284
1.656	520	11.30	18.68	35.9	158.3		

TABLE III.

R.	S.	C.	E.	E_1.
333.6		.020	6.62	6.96
296.5	950	.022	6.58	6.91
259.3		.026	6.64	7.00
222.5		.030	6.62	7.02
185.7	940	.036	6.67	7.09
148.8		.045	6.73	7.13
111.6	945	.061	6.85	7.25
74.5		.092	6.87	7.29
37.95	940	.206	7.80	8.29
30.48	925	.476	14.51	15.7
26.57	925	.594	15.78	17.0
21.65		.899	19.47	21.1
16.70	920	1.96	32.73	35.6
13.76		2.72	37.42	41.1
11.77	905	3.41	40.11	44.3
9.81	900	4.39	43.07	47.9
8.94	890	5.06	45.25	50.9
7.80	870	5.86	45.70	52.6
6.92	840	4.90	33.9	40.4
5.91	670	6.17	22.3	33.3
3.93	550	6.76	26.6	48.4
2.95	510	9.40	27.7	54.4

TABLE IV.

R.	S.	C.	E.	E_1
333.6	1170	.025	8.31	7.11
296 5		.028	8.31	7.11
259.3		.032	8.33	7.14
222.5		.037	8 34	7.19
185.7	1160	.045	8.36	7.21
148.8	1140	.057	8.41	7.33
111.6	1120	.076	8.44	7.54
74.5	1110	.115	8.54	7.70
37.95	1100	.230	8.73	7.93
74.5	1140	.127	9.44	8.29
37.95	1140	.252	9.58	8.61

TABLE V.

R.	S.	C.	E.	E_1.
333.6	1330	.030	9.93	7.47
296.5		.033	9.86	7.42
259.3	1320	.038	9.80	7.42
222.5	1320	.044	9.83	7.49
185.7	1325	.053	9.86	7.46
148.8	1325	.066	9.83	7.45
111.6	1320	.090	10.05	7.62
74.5		.137	10.20	7.73
37.95	1325	.293	11.14	8.56
21.2	1330	1.37	29.01	20.86
16.3	1365	1.99	32.26	23.2
12.3	1350	3.15	33.7	28.7
8.6	1300	4.93	42.8	32.9
7.6	1280	5.78	43.9	34.3
6.6	1230	6.96	46.0	37.4
5.6	960	7.17	40.2	41.8
4.8	880	7.75	36.5	41.4
4.1	850	8.11	33.2	39.1

TABLE VI.

R.	S.	C.	E.	E_1.
333.6	1620	.036	12.01	7.41
296.5	1615	.040	11.92	7.38
259.3		.047	12.27	7.56
222.5		.054	12.02	7.42
185.7	1630	.065	12.05	7.39
148.8		.082	12.19	7.48
111.6	1625	.109	12.22	7.57
74.5		.165	12.29	7.61
37.95	1625	.332	12.60	7.80
26.2	1675	1.31	34.31	20.5
21.2	1675	1.82	33.59	23 1
16.3	1675	2.45	40.01	24.0
12.3	1635	3 42	47.06	28.8
8.6	1260	4.82	41.47	54.4

TABLE VII.

R.	S.	C.	E.	E_1.
333.6	2010	.041	13.7	6.81
296.5		.046	13.6	6.78
259.3		.053	13.7	6.93
222.5		.063	13.9	6.81
185.7	2010	.074	13.7	6.77
148 8		.092	13.6	6 62
111.6	2015	.120	13.4	6.65
74.5		.174	13.0	6.39
37.9	2015	.317	12.0	5.96

38 ohms, the electro-motive force rapidly increases by an amount which is approximately given by the formula, $E = S\ (.042 - .0009\ R)$, from which we see that the electro-motive force continually increases as we diminish the resistance, and, if the resistance could be reduced to zero, would attain the value $E = .042\ S$.

The column E_1 is computed by assuming the electro-motive force proportional to the velocity. This column can be used more conveniently than that marked E, since with small resistances the power required was so great as to make the belts slip, and greatly diminish the speed.

In Table II. some measurements of the power are given, as also the ratio of the theoretical power to that actually employed. The latter was measured by the dynamometer, the former computed by the very convenient theoretical formula, $W = \frac{3}{4}\ CE$. From the results, it will be seen that, for large resistances, the power employed, beyond that required to drive the machine, is insignificant, but rapidly increases as the resistance diminishes; the efficiency also at the same time increasing and attaining its greatest value with the smallest resistances. Of course, the absolute efficiency, or ratio of electricity generated to power expended, would be still less than this, being very small for large resistances, and attaining a maximum of about 30 per cent. When we consider, however, how large an amount of work is consumed by even a small amount of heat, the coefficient in the above cases must be regarded as large.

A series of experiments was next made to determine the strength of the current generated in different positions of the armature. The apparatus was constructed by Mr. S. J. Mixter, and consisted of a wooden wheel attached to the armature, and revolving with it. On this rested a brass wire; and a strip of copper was inserted in the wheel, so that it established contact between the axle and the wire, through an angle of about 10°. The latter was supported by a second larger

wooden wheel, which could be turned and held in any desired position by inserting a pin in one of a series of holes in its circumference, at intervals of 10°. The experiment was performed by connecting the brass wire and axis of the machine with the galvanometer, so that during each revolution of the armature the current would be for an instant diverted through the galvanometer, these currents following each other so rapidly when the machine was running as to produce a sensibly constant deflection. The larger wheel was then turned 10°, and the observation repeated. The 0° and 180° of this wheel correspond to the points where the circuit is reversed by the commutator.

TABLE VIII.

P.	C.	C.
0	.0498	.1015
10	.0503	.0912
20	.0378	.0786
30	.0338	.0693
40	.0284	.0620
50	.0257	.0514
60	.0211	.0399
70	.0159	.0392
80	.0136	.0385
90	.0130	.0392
100	.0141	.0446
110	.0152	.0588
120	.0188	.1000
130	.0343	.1829
140	.0633	.1406
150	.0715	.1367
160	.0678	.1260
170	.0629	.1162
180	.0498	.1015

Table VIII. gives the result of two series of experiments of this kind, the wheel being turned through 360° and the mean of the two readings at intervals of 180° taken. Column 1 gives the angle through which the wheel has been moved, and column 2 the current, the main circuit having a resistance of 16.7 ohms, and the galvanometer circuit a resistance of 1.3 ohms. Column 3 in like manner gives the current when the resistance of the main circuit is reduced to 10 ohms. An examination of this table shows that the current at no point becomes zero, but varies from a maximum at about 145° to a minimum at 90°. If the distance of the poles of the magnet was large compared with the motion of the armature, the current would vary as the sine of the angle, supposing that there was no induction or

other disturbing cause. Accordingly, the current would become zero at two points midway between its two maxima, and this would be the point where the commutator should be placed. In that case, no spark would be seen at the commutator, since the circuit would be broken only when the current was zero. In practice, it was found that there was no portion of the commutator where the spark could be entirely avoided when the resistance was small, evidently owing to the fact shown by these observations, that the current at no point is zero. Moreover, on constructing the curves with coördinates equal to the angles and currents, it will be seen that the inclination is much greater before than after the maximum; so that the latter, as stated above, is distant only about 55° from the minimum, instead of 90°. The cause of the deviation from the curves of sines is probably the current induced by the magnet, which adds or subtracts its effect according as the current is increasing or diminishing.

In trying experiments upon the light produced by the current, several difficulties were encountered. One of the most serious of these was from the slipping of the driving belts, when the machine was running at high rates of speed and the circuit was made through so small a resistance as the regulator and light. From this cause, we were unable to obtain a steady speed of more than, 1,300 revolutions per minute, which was not sufficient to give the best results. A further difficulty was experienced from the great difference in power required to run the machine when the current was passing, and when the carbons became so far separated that the current was unable to pass. A change of probably 4 or 5 horse-power was thus almost instantly made, whenever the current was made or broken, and the consequent shock upon the machinery was very great. It also appeared that the form of regulator used (Duboscq's) was not capable of controlling the current so that the light should be steady. When the carbons were brought in contact, the current was so great that the magnet acted strongly, starting the reversing clock-work and separating them half an inch or more. This broke the circuit, and the machine began to revolve very rapidly; soon the carbons were brought together, throwing a great strain on the engine, and thus they oscillated, producing a very bright light for an instant and then extinguishing it. Better results would probably be attained without the reversing arrangement, by a change in the magnet of the regulator, or by increasing the electromotive force of the current. Some results were however obtained by a very careful adjustment of the spring holding the armature. With a velocity of 1,130 revolutions, a tolerably constant light was obtained.

Current, 3.65 vebers. Resistance in circuit, about 10 ohms. Resistance of light, 3.3 ohms. With a speed of 1,325, total resistance 9 ohms, and current 5.71 vebers, a light varying from 600 to 900 candle-powers was obtained. With a speed of 1,280, resistance 7 ohms, and current 5.20 vebers, the light varied from 650 to 900 candle-powers. Doubtless a much greater light could be obtained with a different regulator and means of obtaining a high speed.

The effects of the current were very fine, and have been frequently described in connection with the Wilde, Gramme, and other machines. Thick wires were melted, heavy weights sustained in the air in the interior of large coils, and excellent diamagnetic effects shown. The induced current on breaking the circuit was very severe when taken through the body, and the spark very long and bright.

The advantages of this machine are its simplicity, compactness, and small weight, compared with other machines of equal power; and little or no trouble was experienced from heating with the currents here employed. In conclusion, we wish to express our hearty thanks to Mr. Farmer for lending us the machine, and hope that we may be enabled to continue these experiments with this and other machines next year, if we can secure an adequate motor and proper means of measuring power.

VII.—ANSWER TO M. JAMIN'S OBJECTIONS TO AMPÈRE'S THEORY.

By William W. Jacques.

It is the purpose of this paper to answer some objections which M. Jamin has made to Ampère's theory of magnetism.

In the Comptes Rendus for Jan. 12, 1874, M. Jamin published the results of some experiments, in which he obtained the laws of the distribution of magnetism in a soft iron bar which formed the core of two coils by measuring the force necessary to detach an armature when placed at different points along the bar. He gives the equations to the curves obtained by sending an electric current through one of the coils, through both coils in the same direction, and through both coils in opposite directions; and finds that the force necessary to detach the armature at any given point is less when the currents are parallel than when opposed; from which he draws essentially the following conclusions:—

1°. If we admit the theory of solenoids, the action of parallel currents ought to be added, and the amount of magnetic intensity to be increased. The reverse takes place.

2°. When the currents of the coils are sent in opposite directions, they ought to act inversely on the particular currents of the iron, and the results should diminish each other. On the contrary, they are added.

3°. The action of the bobbins should, in this case, be nothing at the middle point of the bar. It is not so. We cannot say that there is, at this point, a resultant pole, for it would manifest itself by a point of repulsion.

M. Jamin then states that these results seem to him to require a modification in the theory of solenoids.

Mr. D. Sears has (American Journal, July, 1874) measured the distribution of magnetism in an iron bar which formed the armature of the cores of two coils, by sliding a coil of fine wire, whose terminals were connected with a galvanometer, along this armature, and measuring the instantaneous current induced in this secondary coil when the armature was magnetized by sending a current through the primary coils. His results are opposed to those of Jamin. The case, however, is not exactly that of Jamin, and I have therefore, after repeating Mr. Sears's experiments with similar results, applied this method of measuring the distribution of magnetism, by means of a coil of fine wire, to Jamin's apparatus, as follows: —

I made a bar of soft iron, 50 cm. long, the core of two coils, as in Jamin's experiment, and so connected the coils with a battery that a current could be sent through a single coil, or through both coils in the same or in opposite directions. One of Farmer's thermo-batteries was used as a source of electricity, because of the very great constancy of its current. A small coil of fine wire, like that used by Mr. Sears, was arranged to slide along the bar, and its terminals were connected with a Thomson's galvanometer. When a current was sent through the primary coils, magnetism was induced in the bar, and this, in its turn, induced an instantaneous current in the coil of fine wire, and so caused a deflection of the galvanometer. Although the secondary coil was parallel to the primaries, I found, by substituting a glass rod for the iron bar, that the direct action of the inducing coils on the secondary coil was exceedingly small, excepting when these were brought very near together, which it was not necessary to do in this experiment.

The method used in these experiments is more delicate than Jamin's, as may be shown by constructing curves from the observations in Table I., or by the smallness of the differences in the last column of that table;

and, since we know the positions of the poles of a magnet relatively to a surrounding coil, we may determine the kind of magnetism, or, in other words, the direction of the Amperian currents in either half of the bar, which Jamin's method fails to do.

The results of this experiment, which are directly opposed to those of Jamin, and, therefore, tend to confirm the theory of Ampère, are given in the following table: —

TABLE I.

$x=$	Currents Parallel.	Currents Opposed.	Calculated Mean.	Single Bobbin.	Differences.
15	55	46	50.5	50.0	+ .5
18	33	24	28.5	30.0	—1.5
20	26	16	21.0	21.0	.0
21	23	12	17.5		
22	21	9	15.0		
23	20	6	13.0	13.0	.0
24	19	3	11.0		
25	19	0	9.5	8.5	+1.0
26	19	— 3	8.0		
27	20	— 6	7.0	6.5	+ .5
28	21	— 9	6.0		
29	23	—12	5.5		
30	26	—16	5.0	4.5	+ .5
32	33	—24	6.5		
35	55	—45	5.0	3.0	+2.0

The first column gives the distances from the left end of the bar; column two gives the deflections of the galvanometer for parallel currents; column three for opposed currents; column four the calculated means of columns two and three; column five the deflections due to a single bobbin; and column six the differences between columns four and five.

The equation to the curve of column six is $y = \frac{A}{B^x} = \frac{470}{1.17^x}$, which is the same as the equation obtained by Jamin for the same case.

From the above table it may be seen that, when currents are parallel, the deflection of the galvanometer is greater than when they are opposed; and, when the current is sent through a single bobbin, the deflections are very nearly the means of the other two, as should be the case if Ampère's theory were true.

The conclusions which I have drawn are: —

1°. Parallel currents add to each other.

2°. Opposed currents diminish each other.

3°. The action in the latter case ought to be nothing at the middle of the bar. Experiment shows this to be the case.

Having thus shown the different results of these two methods, I purpose now to show that Jamin's results, instead of requiring a modification of Ampère's theory, are a direct consequence of that theory.

Let us, in approaching this subject, first see what would be the condition of the Ampèrian currents in a bar placed at right angles across the core of an electro-magnet. Suppose the electro-magnet to be placed vertically, and the bar horizontally on top of it. Suppose further that the current passes, in the part of the inducing coil nearest the observer, from right to left. Then, since the Ampèrian currents, in the core of the magnet, would tend, at the angles made by the core and the cross-bar, to induce currents in the cross-bar parallel to those in the core, we should have the Ampèrian currents, in the face of the bar towards the observer, flowing from below upwards in the part of the bar to the right of the core, and from above downwards in the other half; *i.e.*, a current in one direction about the core induces currents in opposite directions in the two halves of the cross-bar.

I have proved this experimentally by placing the coil of fine wire connected with the galvanometer, before spoken of as the secondary coil, at different points on this cross-bar. When the coil was placed to the right of the inducing coil, the deflection of the galvanometer was in one direction; when the coil was placed on the other side, the deflection was in the opposite direction: showing that, in the two halves of the cross-bar, opposite Ampèrian currents do actually exist. That this effect was not due to the direct action of the principal coil on the secondary, was shown by substituting a glass rod for the cross-bar. Let us now, keeping the two bars in the same relative position, make the cross-bar the core of two coils, and let the bar which we have just used as a core represent the armature used in Jamin's experiments. When opposite currents are sent through the primary coils, opposite Ampèrian currents will be induced in the two halves of the bar; and, as the converse of the preceding experiment, parallel currents will be induced in the armature, and these, strengthening each other, will increase the attraction between the bar and the armature. If, on the contrary, parallel currents be sent through the coils, parallel Ampèrian currents will be induced in the bar, and opposite currents in the armature; and, if the armature be placed at the middle of the bar, these currents should neutralize each other and the attraction ought to be nothing.

To prove these conditions of the Ampèrian currents experimentally, I have fixed the secondary coil on the armature at some considerable distance from the bar, and so investigated the conditions of the currents

in the armature, when currents were sent through the primary coils in the same and in opposite directions, with the following results. The armature being placed at the middle of the bar, and parallel currents being sent through the primary coils, there was no deflection of the galvanometer. When opposite currents were sent through the primary coils, the deflection was about 60 mm. A current through a single coil gave a deflection of 32 mm., or very nearly the mean of the other two. A very slight correction was made, due to the direct action of the primary on the secondary coil.

These experiments then gave the same results as those at which we had arrived theoretically, showing most conclusively that this is the correct explanation of Jamin's results.

As a further proof of the illegitimacy of Jamin's conclusions, and a proof which is independent of the secondary coil and galvanometer previously used, I have, using Jamin's apparatus, with the single modification of making the armature quite long in proportion to its diameter, and approaching it to the bar always in such a position that its longer axis shall be parallel to the axis of the bar, succeeded in obtaining results directly opposed to those of Jamin, and in harmony with the result of my previous experiments.

In order to make the experiment plain, let us see what ought to be the condition of the Ampèrian currents in such an armature.

Since it is quite long in proportion to its diameter, the Ampèrian currents would tend to arrange themselves at right angles to its axis; and, approaching the armature in the manner described, the currents in the armature would be parallel to those in the bar. With such an armature, therefore, we ought to have a greater attraction when the currents through the primary coils are parallel than when opposed.

That this is the case I have proved by the following experiment: A small armature of chemically pure iron was made, with a length of 6.5 mm. and diameter of only .8 mm. This was approached, with its axis parallel to the bar, always to the middle of the bar, since it is at this point that the difference in effect of parallel and opposed currents ought to be most marked.

The actual strength of the magnetism of the bar at this point could be varied by moving the inducing coils to or from the middle point, and in this way the intensity was made such that when parallel currents were sent through the coils the armature was supported by the bar. Upon reversing the current in one of the coils and again approaching the armature, the attraction of the bar was insufficient to support it in this position, although it would assume a position at right

angles to the bar, when, as should be the case, it was supported. These results show, as we had expected, that parallel currents increase each other, while opposite currents diminish each other.

The experiment was repeated, approaching the armature with its axis at right angles to the axis of the bar, when results similar to those of Jamin were obtained.

The delicacy of these experiments required a great number of repetitions. This was done, and care was also taken to carefully clean the armature each time lest any moisture from the hands, or other foreign matter, should make it adhere to the bar. Chemically pure iron was used to prevent the armatures acquiring a permanent magnetism.

I have thus attempted to show that the results of M. Jamin's experiments, although undoubtedly correct, do not warrant the conclusions respecting Ampère's theory which he has drawn, but, on the contrary, are a direct consequence of that theory: first, by investigating the condition of the currents in the armature; and, secondly, by showing that contrary results are obtained by making the armature very long in proportion to its diameter, and approaching it always with its longer axis parallel to that of the bar.

XVIII.

MELANOSIDERITE:

A NEW MINERAL SPECIES, FROM MINERAL HILL, DELAWARE COUNTY, PENNSYLVANIA.

BY JOSIAH P. COOKE, JR.

Read, May 11, 1875.

FOR the specimens of this mineral I am indebted to Mr. W. W. Jefferis, of West Chester, Pa., who informs me that the locality is not over 500 yards from the Hallite locality (see these Proceedings, Vol. IX., page 59), lying a little off from the serpentine range in a bed of clay.

The mineral is compact and amorphous. It is very brittle, and its fracture is conchoidal. Hardness about 4½. Sp. Gr., in two determinations (made with alcohol, but referred to water), was 3.390 and 3.392. Lustre, vitreous inclining to resinous. Color, black, with a tinge of red. Streak, brownish red to brick red. Subtranslucent; and, in thin plates, cherry red by transmitted light. Heated before the blowpipe in a closed tube, it decrepitates and gives off water. In the forceps it fuses at about 4½ to an iron-gray mass, which is strongly attracted by the magnet. On platinum wire with soda, it dissolves with effervescence. With borax glass it gives the reactions for iron. The powder dissolves very readily in muriatic acid; but, as soon as the amount added exceeds a certain limit, the solution gelatinizes.

In the following analysis, the water was determined by ignition; the iron and alumina were weighed together, and the amount of iron in the ignited precipitate determined by titration. The silica was separated and weighed in the usual way.

	1	2	3	Average.	Atomic Ratio.	Theory Requires.
SiO_2	7.39	7.45		7.42	49	7.42
Fe_2O_3	75.13			75.13	3.07	79.21
Al_2O_3	4.34			4.34		
H_2O at 100°	6.17	13.85	13.79	13.83	1.54	13.37
H_2O above 100°	7.68					
				100.72		100.00

The last column gives the percentage corresponding to the symbol $\dddot{F}e_4 \ddot{S}i \dot{H}_6$; and it is obvious that the composition of the mineral is remarkably definite, and the agreement of the analyses with theory very close.

Melanosiderite is closely related to the sesqui-hydrates of iron. If the silica could be regarded as an impurity, the ratio between the sesquioxide and the water would be precisely that of Limonite; and, on the other hand, if we regard the basic radical as neutralized both by the silicon and the hydrogen, then the ratio would be that of Göthite. Melanosiderite differs, however, most markedly from both of these minerals in its specific gravity.

	Sp. Gr.	
Göthite	4. — 4.4	Dana's Mineralogy.
Limonite	3.6 — 4.	" "
Melanosiderite	3.391	As above.

Moreover its vitreous lustre, its fusibility, its definite composition, and, above all, its reaction with acids (gelatinizing), indicate that it is a true silicate. The mineral which it most closely resembles, both in external appearance and specific characters, is Hisingerite, but this contains thirty-six per cent of silica. Melanosiderite, however, is evidently a highly basic compound of the same class; and the new species has a special interest, arising from the circumstance that it is a definite natural example of a class of compounds which are so characteristic of the ferric radical. Its amorphous colloidal structure is wholly in accordance with this view of its constitution. The name Melanosiderite is derived from Greek μέλας and σίδηρος, and refers to the very striking black color of the mineral.

The analytical work in this investigation has been done by Mr. W. H. Melville, of the Senior Class in Harvard College.

XIX.

ON TWO NEW VARIETIES OF VERMICULITES,

WITH A REVISION OF THE OTHER MEMBERS OF THIS GROUP.

BY JOSIAH P. COOKE, JR.,

Erving Professor of Chemistry and Mineralogy at Harvard College,

AND

F. A. GOOCH,

Assistant in the Chemical Laboratory.

Presented, May 11, 1875.

SINCE the publication of the writer's first monograph on the vermiculites,* two new varieties of this group of minerals have been brought to his notice by Mr. W. W. Jefferis, of West Chester, Pa., who has most kindly furnished the materials for the following investigation.

The first of these varieties — which occurs at Lerni, Delaware Co., Pa. — has the following characters: The unaltered mineral is of a dull sea-green color, has a highly developed micaceous structure, is an aggregate of rough hexagonal plates, and of very imperfect external form. It is transparent in moderately thin laminæ, and is free from enclosed foreign matter. The optical characters of the mineral closely resemble those of the Culsagee variety of vermiculite, the angle between the optical axes varying in different parts of the same laminæ from 18° to 0°. Its hardness is about 1.5, and three determinations of its specific gravity (taken in alcohol at 23° C.) gave 2.409, 2.368, and 2.373. Heated in a closed tube, it gives off water acid in reaction, changes color, and doubles its volume. Heated before the blowpipe, it fuses to a dirty enamel.

The mineral was prepared for analysis by drying at 100° until its weight was constant, and in this condition was easily decomposed by hydrochloric acid. The bases, after the separation of silica, were con-

* The Vermiculites, their Crystallographic and Chemical Relations to the Micas, by Josiah P. Cooke, Jr. These Proceedings, vol. ix. p. 85. The analytical work in this second paper has been done by Mr. Gooch.

verted into nitrates, and separated by Deville's process. The iron and alumina were weighed together as oxides, and the magnesia as the pyrophosphate. The amount and condition of the iron were determined by decomposing the mineral by the process described by the writer in Am. Jour., vol. xliv. page 347, estimating by a standard solution of potassic permanganate the ferrous iron at once, and the total amount of iron after reduction to the ferrous state. Small amounts of lithium and potassium were found by the spectroscope in the residue obtained in Smith's process for the determination of alkalies, but the total amount of alkali probably did not exceed one-tenth of one per cent of the mineral. The mineral, dried at 100°, lost upon ignition,

(1.)	(2.)	(3.)	(Mean.)
11.65	11.67	11.71	11.68

per cent of its weight. The details of these determinations will be referred to hereafter. Taking, then, 11.68 as the percentage of water in the mineral, the results of analysis are as follows: —

	(1.)	(2.)	(3.)	(Mean.)	Ratio.
$\ddot{Si}$	38.17	37.93	38.00	38.03	2.54
$\ddot{\bar{A}}l$	12.84	13.07	12.87	12.93	.75
$\ddot{\bar{F}}e$	7.02	7.02	7.02	7.02	.26
$\dot{F}e$	.50	.50	.50	.50	.01
$\dot{M}g$	——	29.72	29.57	29.64	1.48
$\dot{L}i$, $\dot{K}$	——	trace			
$\dot{\bar{H}}$		11.68	11.68	11.68	1.30
		99.92	99.64	99.80	

$\ddot{Si}$	:	$\overset{VI.}{\ddot{\bar{R}}}$ + $\overset{II.}{\dot{R}}$	:	$\dot{\bar{H}}$		$\overset{VI.}{\ddot{\bar{R}}}$	:	$\overset{II.}{\dot{R}}$
2.54	:	2.50	:	1.30		1.01	:	1.49
2	:	2	:	1		2	:	3

The second of these two varieties of vermiculite occurs at Pelham, Mass. It has a greenish-yellow tint, resembling closely in color the Culsagee variety. In the specimen examined, however, the scales were very much smaller than those of the Culsagee variety, and exhibited no regular outline. Examined with the microscope, they appeared equally free from interpenetrating material. The plates do not show the striation observed both in Culsageeite and Jefferisite. No evidence of macling could be found. The plates were optically biaxial,

with a small optical angle and strong negative double refraction like the other vermiculites and magnesian micas. The hardness of the mineral is about 1.5; two determinations of its specific gravity (taken in alcohol at 22° C.) gave 2.160 and 2.161. Heated in a closed tube, it gives off water acid in reaction, changes color, and doubles its volume, and in the forceps before the blowpipe fuses to a dirty enamel.

The mineral, dried at 100°, lost upon ignition

(1.)	(2.)	(3.)	(4.)	(Mean.)
11.21	11.50	11.13	11.43	11.32

per cent of its weight. The details of these determinations will be referred to hereafter.

In (1), (2), (3), and (4) of the following analyses, the ignited mineral was decomposed by fusion with sodic carbonate; in (5) and (6), the mineral, dried at 100°, was decomposed by hydrochloric acid. In all, the ferric and aluminic oxides were weighed together, and the former subsequently determined by reduction and titration with a solution of potassic bichromate. In (4), the iron and alumina were together separated from magnesia by precipitation by ammonia, with the usual precautions. In (5), the bases were converted into nitrates, and alumina and iron separated from magnesia by Deville's process. In both (4) and (5), the magnesia was weighed as the pyrophosphate. A trace only of ferrous iron was found. The spectroscope indicated small amounts of lithium and potassium.*

	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)
$\ddot{\text{Si}}$	41.14	41.28	41.04	40.78	41.27	41.23
$\bar{\text{Fe}}$		4.35	4.26	4.49	4.14	
$\bar{\text{Al}}$		43.25	43.52	15.05	15.19	
$\dot{\text{Mg}}$				23.82	28.25	
$\dot{\text{Li}}$, $\dot{\text{K}}$	trace	...	...	...	...	...
$\dot{\text{H}}$	11.32	11.32	11.32	11.32	11.32	
		100.20	100.14	100.46	100.17	

Analysis (5), which probably represents the amount of magnesia contained in the mineral more correctly than (4), affords the ratio,

* In Hallite and Jefferisite, as well as in the Lerni and Pelham varieties, small amounts of lithium were detected. In none of the vermiculites have we been able to detect fluorine.

$$\ddot{\mathrm{Si}} : \dddot{\overline{\mathrm{Al}}} : \dddot{\overline{\mathrm{Fe}}} : \dot{\mathrm{Mg}} : \dot{\mathrm{H}}$$

$$2.75 : \underbrace{.88 : .17} : 1.41 : 1.26$$

$$2.75 : \underbrace{1.05 \quad : 1.41} : 1.26$$

$$\text{or} \quad 2.75 : 2.46 : 1.26$$

$$\text{approximately} \quad 9 : 8 : 4$$

The writer has described (loc. cit.) the remarkable hygroscopic properties of the vermiculites, and the difficulty of separating the constitutional from the hygroscopic water which they may contain. The varieties from Lerni and Pelham offer the same difficulty in the determination of their water, thirty to forty hours being required to bring one or two grammes of either of them to a constant weight at 100° C.

In obtaining a constant temperature of 100° C., an electric regulator was used which differs from other similar forms of apparatus in simplicity of construction. The current is made or broken by a very slight rise or fall of mercury in a U tube connected with a glass bulb within the air-bath. By means of a pressure tap which closes an open L of the connecting tube, the air within the bulb may be confined as soon as the bath reaches the required temperature. After this a very slight increase of temperature raises the mercury column sufficiently to close the electric circuit, and then the current shuts the cock which regulates the supply of gas to the burner under the bath. The chief advantage and the novelty of the apparatus is to be found in the simplicity of this stop-cock, which was suggested by Professor H. B. Hill. It consists of an ordinary chloride of calcium tube placed horizontally, and closed at the larger end by a rubber stopper which allows a considerable freedom of motion to a smaller glass tube passing through it; by this the illuminating gas enters the chloride of calcium tube, from which it passes to the burner. When the current is closed, an electro-magnet acting on an armature attached to the outer end of the small tube plunges the curved inner end beneath the surface of some mercury in the bulb of the chloride of calcium tube, and thus shuts off the main supply of gas; although a small orifice in the side of the inner tube allows a sufficient flow to keep the flame under the air-bath alive. The variation of the temperature of the air-bath does not ordinarily exceed one or two degrees during periods of fifteen to twenty hours, even under great variations of pressure in the gas mains.

Table I. shows the percentages of water found in air-dried specimens

of the Lerni vermiculite, and Table II. shows the percentages of water found in the same specimens dried at 100° C.

I.

	(1.)	(2.)
Loss at 100° C.	5.75	8.12
„ about 300° C.	10.97	
„ red heat . . .		8.60
	16.72	16.72

II.

	(1.)	(2.)	(3.)	(Mean.)
Loss at about 300°. .	11.65	2.54	11.71	
„ red heat . . .		9.13		
	11.65	11.67	11.71	11.68

Table III. gives the percentages of water found in air-dried specimens of the Pelham vermiculite, and Table IV. gives the percentages of water found in the same specimens dried at 100° C.

III.

	(1.)	(2.)	(3.)	(4.)
Loss at 100° C.	10.83	10.72		10.80
„ about 300° C.	4.35	10.27		10.14
„ red heat	5.65			
	20.83	20.99		20.94

IV.

	(1.)	(2.)	(3.)	(4.)	(Mean.)
Loss at about 300° . . .	4.90	11.50	11.13	11.43	
„ red heat . . .	6.31				
	11.21	11.50	11.13	11.43	11.32

The marked hygroscopic character of the Culsagee, Lerni, and Pelham vermiculites led to the idea that the discrepancies between the published analyses of Jefferisite and Hallite might be due to the hygroscopic nature of these minerals. The water contained in each of them was therefore carefully again determined. Table V. gives the percentages of water found in air-dried specimens of Jefferisite; analyses (1), (2) and (4) of Table VI. give the percentages of water found in the same specimens dried at 100°; (3 *a*) gives the percentages of

water found in the mineral dried for three months over sulphuric acid, and (3 *b*) the percentages found in the same specimen subsequently dried at 100° C.

V.

	(1.)	(2.)	(3.)	(4.)
Loss at 100° C.	10.28	9.66		10.17
„ about 300 C. / „ red heat	9.58	4.24 / 5.43		9.36
	19.86	19.33		19.53

VI.

	(1.)	(2.)	(3 *a*.)	(3 *b*.)	(4)
Loss at about 300° C. / „ red heat	10.47	4.70 / 6.01	4.46 / 6.20	4.31 / 6.14	10.42
	10.47	10.71	10.66	10,45	10.42

The mean of (1), (2), (3 *b*), and (4) of Table VI. is 10.51.

It would appear from analysis (3) that the amounts of water lost at 100° C. and over sulphuric acid, during a period of three months, are very nearly identical. Assuming that 10.51 (the mean of the four determinations above) represents the percentage of water in the mineral, dried at 100°, the following scheme contains the published analyses of Jefferisite reduced to this basis. Analyses (1), (2), and (3) are those of Prof. Brush, Dr. Koenig, and Mr. Thomas M. Chatard respectively: —

	Si	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	Total.
(1.)	38.47	18.24	10.92	1.31	20.38	.56	.45	10.51	100.89
Ratio	2.56	1.06	.34	.04	1.02	.02	.01	1.17	
		1.40			1.09				
	2.56	:		2.49			:	1.17	
(2.)	37.25	19.87	8.17	2.36	21.51	—	—	10.51	99.67
Ratio	2.48	1.16	.31	.06	1.07			1.17	
		1.47			1.13				
	2.48	:		2.60		:		1.17	

(3.)	38.04	18.39	8.84	2.33	21.34	—	—	10.51	99.45
Ratio	2.56	1 07	.33	.06	1.07			1.17	
		1.40		1.13					
	2.56	:	2.53				:	1.17	

Table VII. gives the percentages of water found in air-dried specimens of the green variety of Hallite, and Table VIII. gives the percentages of water found in the same specimens dried at 100°. In analysis (4) the mineral was dried for three months over sulphuric acid, and when subsequently heated to 100° for twelve hours met with no appreciable loss..

VII.

	(1.)	(2.)	(3.)	(4.)	(Mean.)
Loss at 100°	3.48	3.19	2.86	2.85	
„ about 300° } „ red heat	12.38	12.86	2.03	2.28	
			10.77	10.55	
	15.86	16.05	15.66	15.68	15.81

VIII.

Loss at about 300° } „ red heat	12.82	13.29	2.09	2.44
			11.09	10.77
	12.83	13.29	13.18	13.21

The mean of (2), (3), and (4), which agree closely, is 13.23. Reducing therefore Mr. C. E. Munroe's analysis of this same variety to this basis, the following scheme represents the constitution of the mineral dried at 100°.

	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	
	36.34	7.54	8.89	1.14	31.84	.47	13.23	99.45
Ratio	2.42	.44	.33	.03	1.59	.01	1.47	
		.77			1.63			
	2.42	:	2.40			:		1.47

It will be noticed, however, that in the case of Hallite there appears to be a constant condition of hydration at about 300°, and that in two experiments the air-dried mineral lost above this temperature 10.77 and

10.55 per cent of its weight. The mean of these values is 10.66; and regarding this as the water of crystallization of the mineral, and reducing Mr. Munroe's analyses accordingly, we obtain the following results: —

$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\bar{\text{K}}}$	$\dot{\text{H}}$
37.17	7.72	9.06	1.18	32.57	.48	11.24
2.48	.45	.34	.03	1.62	.01	1.25
	.79			1.66		
2.48	:		2.45		:	1.25

It would appear, then, that Hallite at 300° is in the same condition of hydration which the other vermiculites examined assume at or about 100°. Now, corresponding to this, there is a very marked fact, indicated by the tables given above, which is worthy of special notice. Air-dried Jefferisite loses, at 100°, about ten per cent of its weight, while air-dried Hallite loses only about three per cent, showing that it holds its water much more firmly than the first. In order to institute a just comparison between the different vermiculites, it is obviously important to seek for each variety the point at which the mineral assumes a constant condition, and maintains it through a considerable variation of temperature. Save only some practical convenience, there is no peculiar virtue in 100°, as the temperature at which a mineral should be dried for analysis. As in the case of crystalline salts we should expect to find for each hydrous mineral a certain point or points of temperature at which it loses the whole, or a part, of its water of crystallization, and certain limits between which it maintains a constant composition. Moreover we should expect that these temperatures would be the more definite in proportion as what we may call the hygroscopic power is the more marked; that, while in some cases the mineral would lose its water at a nearly constant temperature, and the intervals of definite hydration would be well marked, in others the loss would extend over a considerable range of temperature, and it would be more difficult to secure the states of definite composition. That such differences as these are conspicuous among the vermiculites the tables given above abundantly show; but, in addition to this evidence, the difference in the behavior of the several varieties, when heated, impressed upon us more strongly the principle we have stated than the figures would indicate. Nevertheless, as the following table shows, we have been able to bring all the vermiculites to essentially the same

condition. The table is merely a summing up of the results already given, and exhibits a comparison of the atomic ratios * of the several varieties.

	IV. Si.		VI. II. R + R.		II. H.	VI. R.		II. R.
Hallite, at about 300° C.	2.49	:	2.47	:	1.25	.77		1.63
	2	:	2	:	1	1	:	2
Pelham Vermiculite, at 100°	2.75	:	2.46	:	1.23	1.05	:	1.43
	2	:	2	:	1	2	:	3
Lerni „ „ „	2.54	:	2.50	:	1.30	1.01	:	1.49
	2	:	2	:	1	2	:	3
Culsagee „ „ „	2.50	:	2.66	:	1.23	1.37	:	1.27
	2	:	2	:	1	1	:	1
Millbury „ (Crossley)	2.38	:	2.74	:	1.14	1.37	:	1.37
	2	:	2	:	1	1	:	1
Jefferisite „ at 100°	2.56	:	2.53	:	1.17	1.40	:	1.13
	2	:	2	:	1	3	:	2

In the next table we bring together some further noteworthy results, of which the details have already been given, indicating that in the case of three, at least, of the vermiculites we have evidence of different degrees of hydration corresponding to different temperatures : —

	IV. Si.	VI. II. R + R.	II H.	
Atomic Ratio of Hallite Air-dried	2.35 :	2.34 :	1.76	or 8 : 8 : 6
„ „ „ at 100°	2.42 :	2.41 :	1.47	or 8 : 8 : 5
„ „ „ at 300°	2.48 :	2.45 :	1.25	or 8 : 8 : 4
Atomic Ratio of Pelhamite Air-dried	2.45 :	2.19 :	2.32	or 4 : 4 : 4
„ „ „ at 100°	2.75 :	2.46 :	1.26	or 4 : 4 : 2
„ „ „ at 300°	2.90 :	2.59 :	.74	or 4 : 4 : 1
Atomic Ratio of Jefferisite Air-dried	2.30 :	2.28 :	2.17	or 4 : 4 : 4
„ „ „ at 100°	2.56 :	2.53 :	1.17	or 4 : 4 : 2
„ „ „ at 300°	2.68 :	2.65 :	.70	or 4 : 4 : 1

* The atomic ratio is the same ratio which in most works on Mineralogy is still called the oxygen ratio. The numbers given in this paper are found by dividing the per cent of each oxide by a divisor, which is the quotient of the molecular weight of the oxide divided by the quantivalence of the radical. See writer's Chemical Philosophy, page 450, or Paper on Atomic Ratios, Am. Jour., vol. xlvii., May, 1869.

In the last two varieties the ratios correspond to the symbols: —

$$\begin{array}{llll} \overset{\text{VIII.}}{Si_2} & \overset{\text{VIII.}}{O_8} & \overset{\text{VIII.}}{(\underset{\cdot}{R}, R)} & .\ 4H_2O \\ & \text{do.} & & .\ 2H_2O \\ & \text{do.} & & .\ \ H_2O. \end{array}$$

Here again it will be noticed that the differences in the definiteness of these ratios correspond to the differences of hygroscopic power described above. In the case of Hallite, the ratios are almost precisely those of even molecules, while in the case of Jefferisite the agreement is much less close.

In conclusion, we consider that the following general results may be deduced from this investigation: —

First. That all the vermiculites are unisilicates.

Secondly. That these minerals combine with water in several definite proportions, thus confirming the opinion advanced by the writer in his previous paper on this subject, that the water in the vermiculites is water of crystallization.

Thirdly. That all these minerals may be reduced to the condition expressed by the ratio 2 : 2 : 1, which we regard as the normal ratio of the vermiculites.

Fourthly. That the only essential difference between the different varieties of vermiculites is in the ratio between the sesquioxide and protoxide bases.

PROCEEDINGS.

Six hundred and seventieth Meeting.

May 26, 1874. — ANNUAL MEETING.

The PRESIDENT in the chair.

The following gentlemen were elected members of the Academy: —

James Prescott Joule, of Manchester, to be a Foreign Honorary Member in Class II., Section 1, in place of the late Professor Quetelet, of Brussels.

William Hallowes Miller, of Cambridge, to be a Foreign Honorary Member in Class II., Section 1, in place of the late C. F. Naumann, of Leipsic.

Johann Christian Poggendorff, of Berlin, to be a Foreign Honorary Member in Class I., Section 3, in place of the late A. de la Rive, of Geneva.

Francis Wharton, of Cambridge, to be a Resident Fellow in Class III., Section 2.

The annual election resulted in the choice of the following officers: —

CHARLES FRANCIS ADAMS, *President.*
JOSEPH LOVERING, *Vice-President.*
JOSIAH P. COOKE, JR., *Corresponding Secretary.*
EDWARD C. PICKERING, *Recording Secretary.*
EDMUND QUINCY, *Treasurer and Librarian.*

Council.

John B. Henck, Benjamin Peirce, Wolcott Gibbs, } of Class I.

Charles Pickering, Alexander Agassiz, Asa Gray, } of Class II.

Robert C. Winthrop, George E. Ellis, Andrew P. Peabody, } of Class III.

Rumford Committee.

Morrill Wyman. James B. Francis.
Wolcott Gibbs. John M. Ordway.
Josiah P. Cooke, Jr. Stephen P. Ruggles.
Edward C. Pickering.

Committee on Finance.

Charles Francis Adams, Edmund Quincy, } *ex officio.*
Thomas T. Bouvé.

The following Committees were appointed on the nomination of the President: —

Committee on Publication.

Alexander Agassiz. W. W. Goodwin.
John Trowbridge.

Committee on Library.

Charles Deane. Henry P. Bowditch.
William R. Nichols.

Auditing Committee.

Henry G. Denny. Robert W. Hooper.

The report of the Rumford Committee was read and accepted. In accordance with its suggestion, it was voted that the sum of two thousand dollars ($2,000) be appropriated from the Rumford Fund for the publication of Volume IV. of Rumford's Works. Also, voted that the cost of papers by Professors Cooke and Pickering in the Proceedings be charged to the Rumford Fund.

The report of the Treasurer was then read; and, in accordance with its suggestion, it was voted to appropriate, —

For General Expenses	$2,100
For Publication	1,000
For Library	700

It was voted that this meeting adjourn, at its close, to the second Tuesday in June.

Professor Hunt presented a communication on Stellar Spectra.

It was voted that the Secretaries may, at their discretion, give, to authors of original papers printed in the Proceedings, fifty extra copies at the expense of the Academy.

Six hundred and seventy-first Meeting.

June 9, 1874. — ADJOURNED ANNUAL MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary presented Volume IX. of the Proceedings to the Academy.

It was voted to amend the vote passed at the last meeting in regard to extra copies of papers published in the Proceedings, by changing the number from fifty to one hundred.

The President read a report from the Librarian, stating the number of copies of the various volumes of Memoirs and Proceedings of the Academy now on hand.

Professor E. C. Pickering presented a communication on the Pressure of Vapors.

Professor Josiah P. Cooke read a paper by Mr. F. A. Gooch on a new species of Vermiculite.

Professor Asa Gray presented by title a paper on a "Revision of the North American Thistles; and the Characters of certain New Species of Plants."

It was voted that the meeting in August be adjourned to the second Tuesday in October.

Six hundred and seventy-second Meeting.

October 13, 1874. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Professor W. H. Miller, of Cambridge, England, and J. P. Joule, of Manchester, acknowledging their election as Foreign Honorary Members of the Academy.

The President announced the death of Messrs. Fairbairn, Guizot, and Élie de Beaumont, Foreign Honorary Members, and of Messrs. George Derby, Jeffries Wyman, Francis C. Lowell, and Benjamin R. Curtis, Resident Fellows of the Academy.

Dr. George E. Ellis stated that the tomb of Rumford, near Paris, suffered severe injuries during the war; and, in accordance with his motion, it was voted to refer to the Rumford Committee the question whether it was advisable to appropriate any money from the Rumford Fund towards the cost of repairing the monument.

A paper was presented by title, "On the Hexatomic Compounds of Cobalt," by Professor Wolcott Gibbs.

Professor Asa Gray presented, by title, "Contributions to the Botany of the United States, chiefly of the Northern Regions;" a continuation of the paper read by title at the preceding meeting.

Professor E. C. Pickering presented a communication on Graphical Integration.

Six hundred and seventy-third Meeting.

November 11, 1874. — STATED MEETING.

The PRESIDENT in the chair.

The President announced the death of Dr. N. B. Shurtleff, Resident Fellow of the Academy.

Professor Josiah P. Cooke reported that the Rumford Committee recommended that the Academy appropriate one hundred and seventy-five dollars from its general fund ($175), for repairing the tomb of Count Rumford.

Referred to the Committee on Finance.

The Committee reported favorably; and accordingly it was —

Voted, to appropriate one hundred and seventy-five dollars ($175) for this purpose.

The following gentlemen were elected members of the Academy: —

Charles Hallett Wing, of Boston, to be a Resident Fellow in Class I., Section 3.

John McCrady, of Cambridge, to be a Resident Fellow in Class II., Section 3.

William Gilson Farlow, of Cambridge, to be a Resident Fellow in Class II., Section 2.

Sereno Watson, of Cambridge, to be a Resident Fellow in Class II., Section 2.

Julius E. Hilgard, of Washington, to be an Associate Fellow in Class I., Section 2.

William Petit Trowbridge, of New Haven, to be an Associate Fellow in Class I., Section 4.

William Alexander Hammond, of New York, to be an Associate Fellow in Class II., Section 4.

James Hammond Trumbull, of Hartford, to be an Associate Fellow in Class III., Section 3.

James McCosh, of Princeton, to be an Associate Fellow in Class III., Section 1.

Robert Virchow, of Berlin, to be a Foreign Honorary Member in Class II., Section 4, in place of the late Dr. P. C. H. Louis, of Paris.

James Clerk Maxwell, of Cambridge, to be a Foreign Honorary Member in Class I., Section 3, in place of the late P. A. Hansen, of Seeberg.

Professor T. H. Safford presented a communication on the "Motion of the Solar System in Space."

Mr. S. H. Scudder presented, by title, a "Historical Sketch of the Generic Names proposed for Butterflies."

Professor Josiah P. Cooke spoke of the large amount of lead and copper present in commercial tartaric acid and cream of tartar.

Six hundred and seventy-fourth Meeting.

December 8, 1874. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from Messrs. Hammond, Hilgard, McCosh, Trowbridge, Trumbull, and McCrady, acknowledging their election into the Academy.

Mr. W. A. Rogers described the unequal effects he obtained in ruling a glass plate with a diamond point, when the lines were drawn in different directions; and these variations he attributed to the grain of the glass.

The President read a report of the Committee to whom was referred the paper of Professor Benjamin Peirce on Ocean Steamship Lanes: —

The Committee of the Academy, to whom was referred a paper submitted to the meeting of the Fellows held on the 12th of May last, by Professor B. Peirce, relating to the course of navigation over the Atlantic Ocean by steamships passing daily between America and Europe, have considered that subject, and ask leave to report: —

That this is a matter deserving the attention of the society from its growing importance to the safety of multitudes of human beings constantly passing and repassing between the two continents. If the development of this line of navigation for the future is to be measured by its progress during the thirty-five years since it commenced, then it unavoidably follows that without the adoption of some form of systematic precaution there will be a steadily growing danger of serious

accidents from collision, attended by fearful loss of life, not to speak of wide destruction of property.

When the Cunard Company took the lead in this course of enterprise, it sent forth four steamers, which made two passages each way in every month. At that time the hazard from collision was so slight as scarcely to merit consideration. But at this time, when nine steamers often depart in a single day of the week from each side, and more or less in number do so on five other days of the same week, it is obvious that the danger of unexpectedly meeting has become quite serious enough to call for attention, and the consideration of some practical means of guarding against it.

Yet, if it be assumed that so remarkable a development of this navigation has taken place within so short a period of time, the fact implies a probability of an indefinite expansion of it for the future. The relations between the two continents may be said to be even now but in their infancy. Even the modes of conducting them vary from year to year in harmony with the multiplication of the numbers of human beings who make the passage. Sharp competition stimulates the production of larger vessels and of increased power to move them. The aim is also to resort to new means of shortening the period of transit. All these motives combine to increase indefinitely the chances of accident by collision among vessels directed in the shortest course. Each commander is naturally ambitious to be distinguished for the celerity with which he passes from port to port. Each organized company naturally desires to be identified in the public mind with the notion of speed in their vessels quite as much as with that of safety. This in the long run will be sure to produce a rivalry that must inevitably draw all vessels more and more to the shortest line between the ports of destination. Hence must happen a degree of proximity more or less dangerous, especially in doubtful or thick weather and at night.

In making this statement, it is not intended to imply any want of the requisite vigilance to guard against present danger in those who now control this course of navigation. On the contrary, it is believed that all possible care is taken within the narrow compass of authority exercised by each organization. But it is not so much with the present that the danger lies as it is with the future. To secure more safety, greater precaution should be used in advance of the fearful lessons that experience draws from the neglect of it. It would seem that one measure at least might be adopted immediately. There should be some common agreement entered into by all the parties

interested in these modes of transportation to define as clearly as it can be done the precise line of navigation it is intended to pursue.

In connection with these considerations, Professor Benjamin Peirce, who had previously given much reflection to the subject, presented a paper at a meeting of the Fellows of this Academy in May last, the object of which was to suggest the expediency of some friendly action in the way of promoting a general co-operation toward the attainment of this desirable end. The most obvious one is that proposed by him of inviting the concurrence of the various associations in this navigation in establishing a course of what may be denominated Ocean Lanes; in other words, two distinct tracks of specified breadth over the Atlantic, in one of which the steamers bound eastward should direct their course, and those bound westward should as uniformly move in the other.

This idea cannot be said to be new. It was suggested twenty years ago by private individuals; and it has been in some sense adopted and carried out, so far as it was possible for a single company to do it. It is well known that the Cunard Company has laid down a clear course for the direction of its own ships. This rule prescribes for the outward passage to America one crossing the meridian of 50° at 43° north latitude, or nothing to the south of 43°; and for the homeward track crossing the same meridian at 42° latitude, or nothing to the north of 42°. A plan like this is eligible on account of its simplicity; and for that reason, if there was no other, it would seem to recommend itself to general adoption by all other companies. Should each of these, on the other hand, select a distinct and separate course for itself, it is obvious that confusion would be likely to spring up, especially among masters of sailing vessels, who would be best guarded from interposition by the plain and single idea that within certain specified lines of latitude the swift steamers which they most dread are to be met with, and to that end extraordinary watchfulness should there be required.

But, if this track be adopted at all, it would seem to be desirable not only that it be adopted by all steamers crossing the Atlantic in the contrary directions, but that it be steadily adhered to through all seasons of the year. The deviation from the shortest line is scarcely sufficient to make a variation a temptation to save time, especially in view of the advantage of escaping the notorious hazards clustering about the banks of Newfoundland. The anxiety of the best navigators in making that passage at certain seasons of the year, is so strongly felt by them that they would be among the first to rejoice to be relieved from it.

Under these circumstances, the single duty incumbent upon the Academy in this case would appear to be to present the subject to the earnest consideration of all parties interested in the maintenance of these great and growing channels of transportation of human beings, and to urge them by all means to co-operate in some plan of this kind to avoid, so far as they can, the manifestly growing dangers from the extension of their enterprises. If it should be found that, by any other plan than the one proposed, still greater security would be likely to be afforded, such a result would be hailed by us with still higher satisfaction. The great object of saving life and suffering is highly worth any amount of labor and cost expended in attaining it. It does not appear to be within the province of effective legislation. A proper direction given to public opinion all over the commercial world is believed to be far more likely to be efficacious with persons who must largely depend upon public opinion for their prosperity. Neither is there any reason from their past action to infer them to be unwilling to do every thing that may reasonably be demanded to insure the general safety.

CHARLES FRANCIS ADAMS,
GEORGE T. BIGELOW,
JOHN H. CLIFFORD,
H. H. HUNNEWELL,
J. INGERSOLL BOWDITCH, } *Committee.*

It was voted to accept this report, and authorize the Secretary to send copies of it to such of the daily papers and steamship companies as he deemed fit.

The President read a letter from the President of the Geographical Society of Paris, inviting co-operation on the part of the Academy.

Mr. Washburn presented a report of the committee appointed to consider the question of Expert Evidence. It was voted to request this committee to continue their labors.

Six hundred and seventy-fifth Meeting.

January 12, 1875. — MONTHLY MEETING.

The PRESIDENT in the chair.

Professor Wolcott Gibbs announced the discovery of an extensive series of well-defined salts, in which molybdic and tungstic teroxides play the part of bases.

The Corresponding Secretary presented a paper, by Dr. A. A. Hayes, "On the Wide Diffusion of Vanadium, and its Association with Phosphorus in many Rocks."

The President announced the death of the Rev. James Walker, D.D., Resident Fellow of the Academy.

Six hundred and seventy-sixth Meeting.

January 27, 1875. — STATED MEETING.

The PRESIDENT in the chair.

The following gentlemen were elected into the Academy: —

Henry Barker Hill, of Cambridge, to be a Resident Fellow in Class I., Section 3.

James Bradstreet Greenough, of Cambridge, to be a Resident Fellow in Class III., Section 2.

William James, of Cambridge, to be a Resident Fellow in Class II., Section 3.

Joachim Barrande, of Prague, to be a Foreign Honorary Member in Class II., Section 1, in place of the late Élie de Beaumont.

Louis Adolphe Thiers, of Paris, to be a Foreign Honorary Member in Class III., Section 3, in place of the late F. P. G. Guizot, of Paris.

Jean Léon Gérôme, of Paris, to be a Foreign Honorary Member in Class III., Section 4, in place of the late W. von Kaulbach, of Munich.

Professor E. C. Pickering communicated the results of some experiments on the "Foci of Lenses Placed Obliquely," by himself and Dr. Charles H. Williams.

The President read a letter from the President of the Geographical Society of Paris, inviting the Academy to send a delegate to the International Congress of Geographical Sciences, to be held at Paris during the coming summer.

Six hundred and seventy-seventh Meeting.

February 9, 1875. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President announced the death of Dr. Charles G. Putnam, Resident Fellow.

It was voted to refer to the Council the letter read at the last meeting from the President of the Geographical Society.

Professor N. S. Shaler presented a communication on the Freezing of Water in Bomb-shells.

Six hundred and seventy-eighth Meeting.

March 9, 1875. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read a letter from the Royal Institution of Civil Engineers of Ireland, inviting an exchange of publications; also, a letter from the Royal Academy of Brussels, inviting subscriptions to a monument in honor of Quetelet; also, letters from Messrs. Hill, James, and Greenough, acknowledging their election as Fellows of the Academy; also, letters from James Clerk Maxwell, of Cambridge, England, and Jean Léon Gérôme, of Paris, acknowledging their election as Foreign Honorary Members.

The President announced the death of Sir Charles Lyell, Foreign Honorary Member.

The President announced that the letter from the Geographical Society of Paris had been considered by the Council; and, in accordance with their recommendation, it was voted to accept the invitation of the Society, and Hon. R. C. Winthrop was appointed to represent the Academy at the ensuing Congress.

Mr. C. S. Peirce presented a paper on "Photometric Measurements of the Stars."

Professor John Trowbridge presented, by title, a paper on the "Effect of Heat upon the Magnetic Susceptibility of Soft Iron," by H. Amory and F. Minot.

Professor W. Watson presented a copy of his work on "Descriptive Geometry" to the Academy.

Prof. Asa Gray presented, by title, a paper, "A Conspectus of the North American Hydrophyllaceæ."

Mr. Sereno Watson presented, by title, a paper on the "Revision of the Genus *Ceanothus*, and Descriptions of New Plants, with a Synopsis of the Western Species of *Silene*."

Dr. W. G. Farlow presented, by title, a paper on the Algæ of the United States.

Six hundred and seventy-ninth Meeting.

April 13, 1875. — Monthly Meeting.

The President in the chair.

Professor Wolcott Gibbs communicated the following "Optical Notices:" —

1. On a New Optical Constant.
2. On the Determination of Indices of Refraction without the use of Divided Instruments.
3. On a New Optical Instrument.

Professor John Trowbridge read a paper, "On a New Form of Induction Coil."

Professor Trowbridge also communicated two papers from the Physical Laboratory of Harvard College, by undergraduates of the University: —

1. On the Effects of Armatures upon Electro-Magnets, by B. O. Peirce and E. B. Lefavour.
2. On the Time of Demagnetization of Soft Iron, by W. C. Hodgkins and J. H. Jennings.

The Recording Secretary presented, by title, a paper, "On the Light transmitted through one or more Plates of Glass," by W. W. Jacques.

Six hundred and eightieth Meeting.

May 11, 1875. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary presented, in print, the Report of the Council for the past year, which is hereto appended. He also read a letter from M. Thiers, acknowledging his election as Foreign Honorary Member of the Academy. The following scientific communications were then made, but the first two were only read by title: —

On the Application of Logical Analysis to Multiple Algebra, by C. S. Peirce.

On the Uses and Transformations of Linear Algebra, by Benjamin Peirce.

On the Intensity of Twilight, by Charles H. Williams.

On the Light of the Sky, by W. O. Crosby.

On Light Absorbed by the Atmosphere of the Sun, by E. C. Pickering and D. P. Strange.

On Tests of Magneto-Electric Machines, by E. C. Pickering and D. P. Strange.

Answer to M. Jamin's Objections to Ampère's Theory, by William W. Jacques.

On Melanosiderite: a New Mineral Species, from Mineral Hill, Delaware County, Pennsylvania, by Josiah P. Cooke, Jr.

On Two New Vermiculites, with a Revision of the other Members of this Group of Minerals, by Josiah P. Cooke, Jr., and F. A. Gooch.

On a Possible Explanation of the Method employed by Nobert in Ruling his Test Plates, by William A. Rogers.

On the Solar Motion and Stellar Distances, second paper, by T. H. Safford.

REPORT OF THE COUNCIL.

Since the last report, May 12, 1874, the Academy has lost by death twelve members, as follows: seven Fellows, Benjamin Robbins Curtis, George Derby, Francis Cabot Lowell, Charles G. Putnam, Nathaniel Bradstreet Shurtleff, James Walker, and Jeffries Wyman; five foreign Honorary Members, Argelander, Élie de Beaumont, Sir William Fairbairn, Guizot, and Sir Charles Lyell.

BENJAMIN ROBBINS CURTIS.

Benjamin Robbins Curtis was born in Watertown, Massachusetts, Nov. 4, 1809, and died in Newport, Rhode Island, Sept. 15, 1874. He was graduated at Harvard College in the class of 1829, and admitted to the bar in 1832. He commenced the practice of the law in Northfield, Massachusetts, where he remained for two years. In 1834, he became a partner with the late Charles P. Curtis, then one of the leaders of the Suffolk bar. He very soon came to be recognized as a lawyer competent to lead in the most important causes; as one capable of contending with Mason, Webster, or Choate; and familiarly acquainted with all the departments of juridical science.

Judge Woodbury died in 1851, and in September of that year, on the recommendation of Mr. Webster, then Secretary of State, who knew him well, Mr. Curtis was appointed associate justice of the Supreme Court of the United States. The appointment received the cordial approval of the profession throughout New England. On the circuit he was always spoken of as a model judge. He was patient though prompt, courteous though firm, willing to hear and ready to decide. One of the ablest lawyers in the country, who knew him as a member of the Supreme Court, but echoed the common sentiment of the bar when he said of him that, "as a judge of this august tribunal,

it is impossible to imagine one who could be more fully competent to discharge its high and arduous duties." In the autumn of 1857, Judge Curtis retired from the bench, and resumed his practice at the bar in the city of Boston. The announcement of his resignation called forth expressions of regret on the part of his associates, and of the profession from one end of the country to the other.

On his return to the bar, he did not wait for clients. He had won a national reputation. His advice and assistance were solicited from all parts of the country. He devoted himself exclusively to his profession. He had no taste and no ambition for political life. It was not in his nature to be a partisan. His intimate friends were aware that he had carefully considered the grave questions which from time to time agitated and divided the country, and that on these questions he entertained definite and decided opinions, which he neither obtruded nor sought to conceal. He had amassed large stores of general information, but it was only as a profound jurist and able advocate that he was known to the world. He desired to be known in no other way. Nature intended him for a lawyer. In him were combined the moral qualities and the intellectual powers essential to a great advocate and a great judge. These powers he had assiduously disciplined and developed. No matter how multitudinous the facts of his case, or how perplexing the details, his statement was perspicuous and exact. His argument was pure logic. He never indulged in rhetorical display, or used two words where one would do. His style was simple, and his argument was as intelligible to the uneducated juror as to the learned judge.

The life of the lawyer and of the judge is generally spent in settling questions with which the public does not concern itself. It rarely happens to either to be connected with events to be mentioned in history. In the Dred Scott Case, as it is familiarly called, a question arose, upon which the country was divided, and it was the fortune of Judge Curtis to differ from the majority of the court. He felt he had a duty to perform and he did not shrink from it. He delivered an opinion which will stand as a monument to the firmness, the learning, and the logic of its author. He was also the leading counsel in the defence of President Johnson. When the prosecutors had put in their evidence, he in the opening argument announced the principles on which the defence was to rest, and maintained them with such consummate ability, that in the opinion of most competent judges, that argument was fatal to the prosecution. He was followed by his able associates, but it is generally conceded by those who attended the trial

or have read the record, that his argument saved the country from the consequences of a most dangerous precedent.

But the labors of Judge Curtis were so quiet and his life so modest, that the community in which he lived and moved is hardly aware of the great loss it has sustained in his death. Those who knew him intimately will ever feel that his death has created a void which cannot be filled. They admired his integrity, his high sense of honor, his unfaltering devotion to duty, and they *loved him* for his tender, generous, and sympathetic nature.

GEORGE DERBY.

George Derby, M.D., at the time of his death, was one of the highest, if not the acknowledged chief, in sanitary science in this country. He was therefore most appropriately a member of the Academy, although he made few, if any, communications to it. He was born at Salem, Mass., Feb. 13, 1819. His father was John Derby, an eminent East India merchant. Dr. Derby was educated at Salem, and graduated at Harvard College in 1838. After leaving college, he studied medicine, and was known in this community as a well-instructed physician and a most honorable man.

The late war brought out all his sterling qualities. The fall of Sumter sounded like a bugle note to him; and, after reviewing his knowledge of surgery by taking lessons from the most eminent surgeons of the day, he received from Governor Andrew the commission of surgeon in the 23d Regiment of Massachusetts Volunteers. He assumed the duties of that position in November, 1861. He served most faithfully in the armies of the Union for four years, and held many important positions, — as Surgeon of his own regiment and of United States Volunteers; as Medical Inspector of the Department of Virginia and North Carolina; Surgeon-in-chief of Divisions; and finally he attained the rank of Brevet Lieutenant-Colonel of United States Volunteers. During the entire war he was constantly, and at the risk of life and health, at his post, and it is probable that the disease of which he died originated while thus occupied. At the termination of the struggle he was appointed to the command of the Soldiers' Home at Augusta, Maine. This place gave him some rest from the unintermitting toil of the preceding years. He quitted that place Dec. 30, 1865.

During the war Doctor Derby married Elizabeth, daughter of the late William Parsons, Esq. They had four children. Two of the

boys died some months since. The other two boys with their mother are still living.

The fame he had gained during these four years, passed in the service of his country, prepared for him a cordial reception when he settled again in Boston, as a civil practitioner of medicine and surgery. During the war, the subject of hygiene, as applied to large bodies of men in the field, had attracted his attention. Preventive medicine became very attractive to him. Soon after his return to Boston he was appointed one of the surgeons at the Boston City Hospital.

In 1866 he was chosen by the Secretary of the State of Massachusetts as Editor of the State Registration of births, deaths, and marriages. This position he held until his death.

In 1868 he published a small but admirable treatise entitled "Anthracite and Health." It was the first indication he had given of a power to grapple practically with great hygienic problems most important for the future welfare of our people.

In April, 1869, the Massachusetts State Board of Health was established by an act of the Legislature. By the community at large Doctor Derby was "naturally selected" as its secretary and executive officer. He had an immense influence upon the doings and publications of that board. Many of its most important papers were written by him. All passed under his clear, critical eye. Bringing to the task a ripe judgment, he announced his views in a most clear and simple style. His judgment on matters of detail was excellent. His war discipline was invaluable to the board during its earlier struggles.

Especially to him is due the revolution made in our society in reference to slaughter-houses. In the contest with the nuisances at Brighton his calm but decided and gentlemanly deportment, his truthfulness, his appreciation of the inherent difficulties in which the butchers themselves were placed, his indefatigable zeal in season and out of season, were above all praise. Though originally his most bitter opponents, none will now mourn his loss more than the occupants of the splendid abattoir which has risen under his influence on the margin of Charles River. His papers given to the Board of Health brought him to the notice of sanitarians at home and abroad, and at his death his opinion on sanitary matters was becoming daily more valuable not only to America, but to Europe.

In 1872 he was appointed to fill the office of the new Professorship of Hygiene at Harvard College.

He died June 20, 1874, after a few weeks of sudden and most pain-

ful illness, connected with a chronic inflammation of the stomach, and parts adjacent thereto.

As the Academy honored itself when he was chosen a member, so the Academy may well mourn his loss; for there is no one, at present, who can worthily fill his place.

FRANCIS CABOT LOWELL.

Francis Cabot Lowell was born in Boston in 1802. He was the son of Francis C. Lowell, whose name is associated with the cotton manufacture as first successfully pursued in New England, and brother of John Lowell, Jr., the founder of the Lowell Institute.

He was a member, with Ralph Waldo Emerson and other eminent men, of the class that was graduated at Harvard College in 1821.

After some years of foreign travel Mr. Lowell became a merchant, devoting himself to the study of the principles that regulate commerce. These he mastered so thoroughly that he was appealed to, through life, as an authority on all questions of political economy and finance.

That with these endowments, added to his calm judgment and exquisite courtesy, he would have attained, had such been his ambition, a high rank in any sphere of public activity does not admit of a doubt. But neither his health nor his inclination permitted such aspirations. He was of too lofty and serene a temperament to descend into the struggles of the arena. He could not flatter a constituency or submit his fortunes to the caprices "popularis auræ." He preferred the independence of a private station.

He was successively Treasurer of the Amoskeag and of the Merrimac Manufacturing Companies, and Actuary of the Massachusetts Hospital Life Insurance Company, — trusts of high responsibility and requiring very varied powers. Few men, perhaps, could have so satisfactorily discharged the duties of all three; fewer still would have had the philosophy to retire voluntarily from each, in the meridian of their powers and with the halo of success.

Equanimity, dignity, and decision marked his character. Fearless by nature, he had the courage of his opinions. Yet such was the sweetness of his manners, that, though outspoken, he never gave offence. To those who had claims on his sympathy he was the most steadfast friend, the wisest counsellor.

These qualities, so rare in their union, could not fail to impress themselves on his demeanor. A distinguished British professor writes of him: "His look and presence were noble in the extreme, and bespoke the gentleman of the old school. I never saw dignity

more clearly expressed on any face, — the dignity of a deep-seated self-respect. His courtesy had an old-world elegance in it. His kindness, that could not be surpassed, was all the more valuable as being accompanied by an outward manner suggestive of self-repression and wholly antithetic to emotional display. In fact he was so noble and grand and good a man that pity seems a feeling incongruous with any circumstance connected with him, incongruous even with his death. I feel a sincere sorrow; but it is a sorrow intermingled and softened by a supreme admiration. He will abide in my memory as the *beau idéal* of the gentleman in the lighter respects of manner and appearance and in the weighter respects of feeling and character."

DR. CHARLES G. PUTNAM.

Dr. Charles G. Putnam was born in Salem on the 7th of November, 1805. His father was the Honorable Samuel Putnam, Judge of the Supreme Court of Massachusetts, his mother a niece of Timothy Pickering, the Secretary of State during Washington's and Adams's administration. He was fitted for college under the direction of Mr. John Brazer Davis, and graduated at Harvard in 1824. He studied medicine with the late Dr. A. L. Peirson of Salem, and took his medical degree in 1827. During six years of residence in Salem he was Physician of the Dispensary, Secretary of the School Committee, Physician to the Almshouse, Cabinet Keeper of the Essex Historical Society, and Physician to the Board of Health.

In 1833 he removed to Boston, and in 1835 married the eldest daughter of the late Dr. James Jackson, with whom he entered into professional partnership, which continued until the death of Dr. Jackson.

He remained in practice in Boston during the rest of his life, constantly and quietly busy, with few interruptions, the most important of which was a visit to Europe of only four months in 1851. His unassuming excellence as a practitioner and as a man was recognized in the various honors which sought him in his little conspicuous path of daily duties. He was made Physician to the Lying-in Hospital, President of the Suffolk District Society, President of the Boston Obstetrical Society, Consulting Physician of the Carney Hospital and of St. Joseph's Hospital, and in 1868 President of the Massachusetts Medical Society.

In 1857 he was chosen a member of this Academy. His special pursuits hardly furnished materials for papers to go upon its record,

but he found great pleasure in attending the meetings and listening to the various communications from the distinguished men of science who gave these meetings their chief interest.

The few publications Dr. Putnam has left relate chiefly to the diseases of women and the practice of obstetrics, to which branches he was more particularly devoted. His translation of Louis on Blood-letting introduced to the practitioners of this community a work which has done much towards forming the professional creed of the present generation.

He died very suddenly after some threatening cerebral symptoms, which however had left him capable of work and of enjoyment, on the 5th of February, 1875.

His best record, because the amplest and the one that tries all a man's qualities, is the memory of a life that was mainly spent in going about doing good, without show, without noisy claim of acknowledgment, without envy or jealousy. Single-hearted in the service to which he had given himself, diligent, patient, skilful, he lived serenely and died peacefully, leaving many mourners and not one enemy.

NATHANIEL BRADSTREET SHURTLEFF.

Nathaniel Bradstreet Shurtleff, M. D., F. S. A., died in Dorchester, on the 17th of October, 1874. He was in his sixty-fifth year, having been born in Boston on the 20th of June, 1810. His father, Dr. Benjamin Shurtleff, a native of Carver, in the County of Plymouth, and a graduate of Brown University of 1796, removed about the beginning of this century to Boston, where he was for many years a practitioner of eminence. He came of the purest of the Pilgrim stock, no less than six of his ancestors having been of the company of the Mayflower. It is doubtless to this descent, and the interest in the early history of New England which it excited, that we owe the numerous antiquarian and historical works by which Dr. Nathaniel Shurtleff is best known and will be chiefly remembered. His earlier education was had at the public schools of this city, but his preparation for college was finished at the Round Hill School at Northampton, then at the height of its success, under Messrs. John G. Cogswell and George Bancroft. He graduated at Cambridge in 1831, and at once entered on his professional studies, taking his degree in medicine regularly in 1834. He was fairly successful in the practice of his profession, but his taste lay rather in other directions, and latterly they much diverted his attention from his hereditary vocation.

The first publication of Dr. Shurtleff, about the time of his receiving his medical degree, was a small treatise on Phrenology, a subject in which the visit of Dr. Spurzheim to this country in 1832 had excited a certain degree of interest at that period. It was entitled "An Epitome of Phrenology," and consisted of an abstract of the theories of the school of Gall, Spurzheim, and Combe, written in the spirit of a believer, but without endeavoring to re-enforce those doctrines by fresh examples or arguments. It was fourteen or fifteen years after this publication before Dr. Shurtleff again appeared as an author, when he began in 1849 the series of works relating to our early history by which his later life was distinguished with a little tract entitled "The Passengers in the Mayflower," which compressed the results of great research and industry within a narrow compass. This was followed by brief Genealogical Memoirs of William Shurtleff and of Elder Thomas Leverett, and by a monograph, privately printed, on the "Deaths at Marshfield in 1658 and 1666 by Lightning." A little later Dr. Shurtleff was intrusted by the General Court of Massachusetts with the editorship of "The Records of the Governor and Company of the Massachusetts Bay in New England," the first two volumes of which appeared in 1853. The next year he published three more volumes bringing the Records down to the Presidency of Joseph Dudley. In 1855, Dr. Shurtleff was appointed by a legislative resolve to edit the "Records of the Colony of New Plymouth in New England," the first four volumes of which appeared in that year, followed by the fifth and sixth in 1856, and the seventh and eighth in 1857. In the year 1858, the political complexion of the State government having changed, that great cardinal doctrine of our modern politics, Rotation in Office, devised to secure the Survival of the Unfittest, was applied to him, and he was relieved from the task he was so eminently fitted to perform. He discharged this laborious duty in the most thorough and conscientious manner. In his own words, he "closely collated the proof-sheets with the original record, and consequently, with considerable labor, compared every word of the printed copy with the original manuscript, and also revised all doubtful words and passages with the same." Among his smaller publications may be mentioned "A Perpetual Calendar for Old and New Style," designed to relieve the student of history from the embarrassments sometimes occasioned by the difference of the two styles. Also a "Decimal System for the Arrangement and Administration of Libraries," which described the plan he had himself invented for the management of the Boston Public Library, when he was one of the original trustees of that institution,

and which is still employed with considerable modifications in its administration. In 1862, Dr. Shurtleff edited "A Literal Reprint of the Bay Psalm Book" with his usual conscientious accuracy, and enriched it with a short bibliographical notice of much value to the curious student. Unfortunately there were but fifty-six copies printed, so that the reprint is almost as hard to come by as that rarest of bibliomaniacal curiosities.

Dr. Shurtleff was a Bostonian of the Bostonians, and had a passionate affection for his native city, which led to an immense collection of materials for the illustration of her history and antiquities. A portion of these he employed in the preparation of the most important of his works,—"A Historical and Topographical Description of Boston," which was published in 1871. This volume contains more information on the subjects of which it treats than can be found elsewhere, and yet but a quarter part of the material he had been collecting, for more than forty years, was employed in its preparation. It is to be hoped that the remainder of these important collections may have been left in a shape to be made useful hereafter. So devoted was he to his native city that it is said that he had slept but two nights out of its limits since he left college, and those were most characteristically given to Plymouth. In 1867, Dr. Shurtleff reached the position which probably was the highest object of his ambition, being elected Mayor of Boston as the candidate of the Democratic party. The next year he was again elected on the nomination of the Democrats, and in 1871, having lost the nomination of that party, he was triumphantly chosen as an independent candidate by a plurality of nearly 8,000 votes. After having received this most honorable testimony to his administrative merits, he declined a re-election. During the Rebellion, he was active in promoting the cause of the Union, and gave both his sons to the military service of the country, of whom the eldest, bearing his name (H. C. 1859), fell at Cedar Mountain in August, 1862, at the age of twenty-four. Dr. Shurtleff was elected a Fellow of this Academy in 1853, and was also a member of the Massachusetts Historical Society, of the American Philosophical Society held at Philadelphia, of the American Antiquarian Society, of the Royal Society of Antiquaries of London, and of many other learned bodies. His life was marked by a constant activity in useful directions, and it was crowned with the testimony of a good conscience, with the friendship of many eminent men, and with the respect of the general public.

JAMES WALKER.

James Walker was born in Burlington (at that time a part of Woburn), Mass., on the 16th of August, 1794. He fitted for college at the Groton Academy, which was then under the charge of Mr. Caleb Butler. This preparation extended (with several interruptions) from the autumn of 1807 to that of 1810. He entered Harvard College in 1810 and graduated in 1814. Though he held no prominent rank in his class during the freshman year, on account of his imperfect and irregular course of preparatory studies, he steadily gained ground, and, at the close of the senior year, the second English oration was assigned to him. He was not, however, so engrossed in his studies as to have no leisure for the society of his classmates, whose respect and love he early won and always retained. Their appreciation of his abilities and character was manifested by electing him to be their class orator. The intimacies which he formed in college were judiciously chosen, were darkened by no cloud, and terminated only with life. On the last Commencement, the seven other surviving members of his class were invited to dine with him; and all but one were able to be present, to celebrate the sixtieth anniversary of their graduation. Mr. Walker spent the first year after leaving college at Phillips' Exeter Academy as an assistant teacher. He then returned to Cambridge, and began his theological studies as a resident graduate on the 15th of October, 1815. His class is entered in the Triennial Catalogue as the first in the Divinity School, graduating from it in 1817. But the school can hardly be said to have been organized at that time. It had no teachers exclusively devoted to it. Most of the instruction was given by Dr. Henry Ware, the Hollis Professor in Divinity, assisted by President Kirkland, Professor Sydney Willard, and Mr. Andrews Norton.

At a meeting of the Boston Ministerial Association, held at the house of Dr. William E. Channing on May 5th, 1817, Mr. Walker received the usual approbation or license to preach; and he preached for the first time, on the Sunday following (May 11th), for the Rev. Samuel Sewall in his native town. On the 22d of September, 1817, he had a call to settle in Lexington, Mass., which he declined. On the 11th of February, 1818, he was invited to the Harvard Church in Charlestown, Mass., and was ordained on the 15th of April. The history of this society virtually begins with his ministry, as his only predecessor, the Rev. Thomas Prentiss, died in about six months after his settlement. Other young ministers of that day created at first a

greater sensation than was produced by Mr. Walker. But he knew what was in him. Soon after he was settled, he said to a friend and classmate that it was not wise for a young minister to put every thing into his first sermon, otherwise he would soon find himself aground. The reputation of Mr. Walker as a vigorous, eloquent, and convincing preacher rapidly increased and extended. In 1822 he was urged to take charge of a society in Washington, D.C. In 1823 the strongest appeals were made to him to settle in Baltimore. No one else was thought to be so well qualified by abilities and courage to defend these outposts of the denomination. It was not the exposure of these new positions which led Mr. Walker to decline them; but loyalty to the people and church which had chosen him for their minister, and which, as he modestly said, had manifested for him a "degree of affection and attachment which has left me nothing to regret but that it was not better deserved and better rewarded." In his reply to the Baltimore invitation occurs the following characteristic remark: "I am not unapprised of the difficulties to be encountered by him who shall be your successor; his arduous duties, his great and undivided responsibility, widely separated from the main body of his theological friends, and in frequent collision with his opponents, numerous, active, and implacable. But, formidable as these obstacles may appear to some, they have no terror for me: nay, so far from shrinking from them, I would go forward to meet them."

Dr. Walker preached his farewell sermon to his people on July 14, 1839, after a devoted ministry of twenty-one years; during which his society had grown from ninety-five families to about two hundred and twenty-five. He resigned his pastoral charge in order to accept an appointment to the Alford Professorship of Natural Theology, Moral Philosophy, and Civil Polity in Harvard College. Every possible effort was made, independently, by the church, the congregation, the Sunday school teachers, and the young men of his society, to induce him to withdraw his request for a dismissal. But he was not a man to have come to a decision on an important step in life before he had looked at it from all sides. His people trusted implicitly in his honor and the purity of his motives, and, though disappointed, they acquiesced in his conclusion with Christian grace. If the separation was painful on both sides, not a friendship was broken, nor a confidence impaired; and when on the 16th of August, 1874, some of Dr. Walker's friends desired to commemorate his eightieth birthday by a substantial expression of their love and veneration, none more eagerly embraced the opportunity than the survivors among his old parish-

ioners, from whom he had been separated for thirty-five years; for his memory was still green in their own hearts, and had been instilled into the hearts of their children and grandchildren.

There were those among his clerical brethren who advised Dr. Walker against accepting his appointment to a professorship, fearing that he would be lost to a ministry which could ill afford to spare him. But others, and among them Dr. W. E. Channing, urged him to go to Cambridge. He said: "To guide the young to just principles of moral and intellectual philosophy is to contribute more to their education than any other teaching can do." The event has proved that what was gained to the college was not so much lost to the churches. During the period of more than twenty years while Dr. Walker was Professor or President, and afterwards, as long as his health permitted, he preached frequently in the college or other pulpits, and with ever-increasing power and attractiveness. After he had retired from the Presidency of the college to private life, in the sixty-sixth year of his age, with some bodily infirmities, but in the full possession of all his grand thoughts, and the fire of his old eloquence to utter them, he was invited to the pulpit of King's Chapel in Boston. There can be no doubt that, whatever else Dr. Walker was or might have been, he was born to be a preacher, and possessed all the qualities of mind and heart, and all the physical gifts, which fit a man to be a great preacher; reverence, sympathy, a searching logic, a deep insight into character, a simple and terse style, and an inspiring look and voice which made the manner an exact counterpart of the matter. What he had to preach is best stated in his own words, taken from an installation sermon printed in 1823. "Mere moral lectures, which a heathen philosopher might have preached as well, will not answer; nor ingenious and subtle disquisitions respecting the foundation of morals, or the fitness of things, or the beauty of virtue, or the counsels of mere worldly prudence. All this may be very well in its place, and it need not be entirely excluded from the pulpit: but it is not preaching Christ; and that minister will find himself to have sadly erred, who depends upon it mainly for success. We find none of it in the discourses of the Saviour; none of it in the preaching of the Apostles. It was not by such means that Christianity was established, or the Reformation begun: nor is it by such means, even at the present day, and notwithstanding all the changes that have taken place, that interest and popularity can be given to any system of doctrines, or the bulk of any congregation be kept awake, or their souls saved from death."

Though Dr. Walker habitually held himself to a strict account to

be spiritual and practical in his sermons, no one could excel him on occasion, in speculative, doctrinal, or controversial preaching. Witness his sermon on the philosophy of man's spiritual nature printed in the "Unitarian Tracts;" or his sermon on the nature of God, preached at the ordination of Rev. Ephraim Peabody; or his sermon on faith, regeneration, and atonement, prepared for a dedication in Leicester; and then turn for an example of his spiritual and practical preaching to his sermon on the law of the spiritual life, or the life of the soul. It can be said of few preachers as truly as of Dr. Walker that he interested and instructed all classes, the most intellectual and the most simple-minded, the youngest and the oldest among his hearers. Perhaps there is no harder ordeal by which a preacher can be tried than when he addresses a body of college students. It is not that such an audience is more intellectual, or more sceptical, or more frivolous than other congregations. But, instead of a mixed assembly of men, women, and children, this is mostly of one kind, surrounded by all the associations of college life, and sometimes affecting to be less serious than it really is. Whatever of conceit or of fallacy was contained in the student's judgment of the utility of the Sunday services for him, Dr. Walker was able to probe to the core and expose, as in his sermon on the Student's Sabbath. By a happy selection of topics (as in the sermon on St. Paul or the Scholar among the Apostles), by a profound analysis of his subject, by an inexorable logic which riveted the attention, he took possession of the minds of his hearers, but only that he might bring home to their consciences, their hearts, and their lives, the application of the truths which he had slowly evolved. Moreover, the solemnity and earnestness of his manner assured them that he felt himself that he was not dealing with abstractions, but with realities. He believed that this was the deep secret of pulpit influence. These are his own words: "Surely he who can preach otherwise than seriously and earnestly must be without an adequate conception of man's need of religion, or of the divine compassion in providing it, or of the strength and inveteracy of that corruption against which he is to contend, or of the character and extent of that misery for which he is to indicate a remedy or a consolation. And let him not think to inspire a feeling which he does not himself possess. However learned or ingenious or eloquent, let him not think to kindle in others a zeal for God and a devotion to his cause, unless he speak from that same zeal and devotion burning in his own bosom. However rich and costly may be the offering which he brings, let him bring fire with it, and not think to kindle the sacrifice by blowing upon the cold hearth

of the altar." No other recognition of his services, during his long and honored life, gave Dr. Walker so much satisfaction as the assurances which he continued to receive from the young men that his preaching had done them permanent good. His sermons were not of the kind which can be once heard and then forgotten. In every one of them there are characteristic expressions which are remembered and repeated by his hearers after an interval of a quarter of a century. The influence which Dr. Walker exerted from the pulpit did not come exclusively from his sermons. His devotional exercises were brief, without vain repetitions, but deeply impressive. His manner of reading the Scriptures was majestic. It may be doubted whether human lips ever gave them greater force and meaning since they have been read in the churches. His commanding presence in the pulpit, the wonderful selections which he made from the Bible, and the strength and feeling with which they were uttered, always made the greatest occasions appear still greater.

Dr. Walker was admirably qualified by his intellectual preferences, his even temper, and his interest in young men, to teach in the department to which he had been chosen at Cambridge. His own mind was wedded to no particular school of philosophy, but was essentially eclectic, and ever open to new light from whatever quarter of the intellectual firmament it might come. The students soon learned to find in him a friend as well as a teacher, and sought his advice, not only in their studies and their troubles, but in the choice of their career in life. After having discharged the duties of professor, in the most acceptable manner, for nearly fourteen years, he was made President of the University in February, 1853, and was welcomed to this office by the unanimous voice of the community. He had already been a Fellow of the Corporation since 1834, and had been Acting President during the interval between the administrations of Mr. Quincy and Mr. Everett. No one understood better than he did the labors and responsibilities of president, or the condition, wants, and prospects of the University; and no one of his illustrious predecessors administered its affairs with greater assiduity and impartiality, or was rewarded by more decided marks of public confidence. The personal attachment which the students had formed for him while he was their teacher made it comparatively easy for him to govern them as president. He had also the hearty and undivided support of all his associates in the various offices of instruction and government. When youthful indiscretions or grave offences were committed by any of the students, the offenders suffered as much in the consciousness of his displeasure as

from the college punishment which was inflicted. Dr. Walker did not make too much account of college misdeeds, and never despaired of a young man, even if vicious, hoping every thing from the reflections of his better moments and the experiences of life. Though he was sometimes doomed to disappointment, his hopes were oftener realized, and the college delinquent became an honored member of society and sometimes an ornament of the University. There are many men in the community, now in the prime of life, who will gladly confess that their character and prospects were determined for them by the judicious counsels of a president, who was severe to uncover their faults and follies, but who was always gentle to forgive and ready to encourage. The annual reports which he made to the Overseers indicate a rapid increase in the number of students and in the facilities for instruction during his administration. During this period the Appleton Chapel, Boylston Hall, and the Gymnasium were built, and the Museum of Comparative Zoölogy was founded.

Education in all its grades, and religious as well as secular, had always enlisted the sympathy and support of Dr. Walker. Before the establishment of Sunday schools he himself gave religious instruction to the children of his own parish. He was an active member of the school committee of Charlestown, a constant attendant at the College with one of the examining committees of the Overseers, and a friend to the Divinity School in Cambridge. He prompted young men to seek the highest education and gratuitously fitted more than one for it. On two occasions, viz., in 1831 and again in 1856, he delivered the introductory lecture before the American Institute of Instruction. After quoting the remark of an old English divine who said that "schoolmasters have a negative on the welfare of the kingdom," he added: "They may be said to *create* a republic, and the time has come when, under institutions like ours, we could no more dispense with the profession as a distinct profession than we could with that of the ministers of justice or religion." Dr. Walker believed in common education; but the education which he wished to make common was the best education. Wherever the highest intellectual gifts were found, he would have them put in the way of the highest intellectual culture. In that anarchy of thought which was formerly repressed by "authority in church and state, by the fetters on men's hands or the fetters in their souls," but which now stalked madly through the land, he saw no hope unless some could be found "in every department of human knowledge, so incontestably superior, as to become, in that particular department, the legitimate and accepted lights and guides of the age." To this end

they should be taught something about a good many things, but every thing about at least one thing. But before all systems of instruction he placed character; as character alone would enable the young to profit by the many accidental circumstances which schools and colleges do not create and cannot prevent.

Dr. Walker had been a member of the Board of Overseers of Harvard College from 1825 to 1836: after resigning the office of President in 1860, he was again elected into that body, at the first opportunity, and remained in it to the day of his death. His services in that board are well expressed in the words of one of his associates in it. "With this long experience, his comprehensive and trained intellect, sound moral nature, his devotion to the college, his clear and forcible statement, his modesty and courtesy, gave to his judgment at this board an authority which no other could command." With this exception, when Dr. Walker left the office of President, he relinquished all official responsibility. The fifteen years of comparative leisure and retirement which he then enjoyed made the happiest period of his life. And yet, perhaps, no other period could show greater intellectual activity, or overflowed in richer blessings to others. The mere presence of such a man in any community, — so strong in thought, so abundant in learning, and yet so accessible to young and old; so severe in his principles, and yet so lenient in his judgments; so firm in his own convictions, so liberal to others; ever ready to give good counsel when it was asked, but with no desire to force his opinions upon unwilling minds; often a peacemaker between those who were alienated, but without any quarrels of his own, — the presence of such a man in the community is a benediction. But more than this. Dr. Walker was ever prompt to respond, to the full measure of his physical strength, to the many public calls which were made upon him, in the name of patriotism, good learning, and religion. The sermon which he preached in King's Chapel, on the 12th of May, 1861, on the "Spirit proper to the Times," though it does not contain a harsh word, was nevertheless a trumpet-call to arms. Where can be found a more masterly analysis of the causes, remote and proximate, of the troubled state of the country during the war of the great rebellion, than in Dr. Walker's sermon, preached before the Government of Massachusetts, at the annual election, on Jan. 7, 1863? And who can forget his thoughtful and inspiriting address, on the "Duties of Educated men to the Country," delivered before the alumni of Harvard College, on July 16, 1863, in which he closed with a most eloquent appeal to the living alumni to erect a monument to their dead heroes? "Do not," he said, "cover it

over with a glorification of our institutions, or of our people, or even with a studied eulogy of the dead; thus to have offered up their lives is glory enough. Write on it these few simple words: In memory of the sons of Harvard, who died for their country."

At the request of the Massachusetts Historical Society, Dr. Walker prepared two memoirs: one of Daniel Appleton White, which was printed in 1863; and the other of Josiah Quincy, which was printed in 1867. Dr. Walker was no less fortunate in the subjects of these memoirs than they were in the just and discriminating treatment which they received at his hands. Born at nearly the same time, and, after living to a very advanced age, dying within a few years of each other, these two distinguished men cover with their lives "the whole of our proper unchallenged national existence." Trusting and honoring one another, and trusted and honored by the public, they were conspicuous actors, each in his own way, in the scenes which passed before them; and many of the great movements in church and state, and many of the great questions relating to government, education, morals, or religion, which agitated their times, received an impression from their minds and characters. To write the memoirs of such men, learning, research, wisdom, independence, delicacy, were required; and all these qualifications Dr. Walker brought to the work in large measure. An intimate friend of Judge White for many years, and closely associated with President Quincy during his administration, he could speak, as one having authority, of their noble characters and their honorable and useful lives.

In 1840, Dr. Walker was invited to deliver courses of lectures on Natural Religion, before the Lowell Institute in Boston; which he gave in three successive years. The first course treated of the psychological grounds of Natural Religion. Scientific Theology, or the logical grounds of Natural Religion, was the subject of the second course. In the last the analogy or harmony between Natural and Revealed Religion was discussed. These carefully prepared lectures produced a deep impression on the large and intelligent audiences which heard them. Had they been printed at the time, according to the wishes of the administrator of the Lowell Fund, they would have instructed a still wider public. But their publication was postponed by Dr. Walker, in the hope of gaining leisure for a careful revision of them; a leisure which, in his crowded life, he never found. After an interval of twenty years, he was asked to repeat them before the Lowell Institute. He excused himself from a literal compliance with this invitation for these reasons: "Several of the topics considered by

me have since then been earnestly discussed by writers of great ability. Accordingly, any treatment of them which should omit all notice of these works would be justly regarded as behind the age. I should also be sorry to think that my own mind, during so long an interval, had made no progress in correcting and clearing up its conceptions on points, many of which, to say the least, are still far from being definitely settled. I love consistency; but I love truth still more. Old as I am, I am not ashamed to learn. Under these circumstances, so far as I make use of the old materials, I shall feel it to be due to myself, as well as my audience, to rewrite and restate every thing. And this is not all. Instead of taking up and following out the same line of argument as before, I shall limit myself, for the most part, to what may be called, so far as the public take concern in these matters, the problems of the day, and so be able to discuss them at much greater length." The subject of this new course of lectures was the Philosophy of Religion.

What Dr. Walker said of himself at this time remained true of him to the end. He was never ashamed to learn. Though his mind was unusually mature at thirty years of age, the ripe fruit continued to hang upon the tree, growing larger and more perfect with every summer sun for half a century longer. He read largely, and digested what he read; keeping himself familiar with the latest thought on science, philosophy, education, and religion. Amid the revolutions and distractions in human thought and society, he never lost his faith in man or God. Dark problems, which troubled many spirits, he discussed dispassionately and hopefully. He continued to think and write on such subjects to the latest moment, and the ink was scarcely dry upon the last sheets when the summons to prepare for the great change came to him. Besides fifty unprinted sermons, he has left a large amount of manuscript, but no wholly completed work. In his final illness, he expressed regret that he had not had time to finish one work which he thought might do some good. Formerly, he said, religion was every thing and science nothing; now, in the opinion of some, science is every thing and religion nothing. The subject which he undertook to discuss, and upon which he has written at great length, is this: "Are men outgrowing Religion?" He has also left a long and elaborate analysis of the lives and opinions of atheists and alleged atheists. "Is God Knowable?" is another of his subjects. He projected an exposition of the New Testament, which he began, and carried into the seventh chapter of Matthew. He prepared, probably while he was professor, portions of a manual on Comparative Psychology.

Dr. Walker often studied and wrote under great physical disabilities. For many years his eyes were weak, and he was forced to employ a reader. At another time he suffered from cramp in the fingers, so that he was obliged to hold his pen in one hand and guide it with the other. He was never a fluent or rapid writer. He generally spent so much time in thinking over his subject that he wrote at last under pressure. The remark occurs once in his diary, that he would not again allow himself so much time to write a sermon. After he had once welded a sentence in his heated brain, it was strong as iron, and incapable of improvement. Hence, he seldom corrected his own manuscript, and the material which he has left might be sent to the press without the change of a single word. He never shrank from a homely expression, if it conveyed his meaning; and whenever he indulged in the graces of rhetoric, the effect was heightened by contrast with the massive columns below. Of all which Dr. Walker had written, but little was published during his lifetime. A volume containing twenty-five of his sermons appeared in 1861, and at other times single sermons and addresses. He contributed more than fifty articles, besides short notices, to the "Christian Examiner," and he was the sole or associate editor of it from January, 1831, to March, 1839. While he was professor, he edited "Reid's Essay on the Intellectual Powers, abridged, with Notes from Sir William Hamilton;" also, "Dugald Stewart's Philosophy of the Active and Moral Powers of Man."

All the honors which a life so long, so laborious, so useful, had richly merited, were freely bestowed and meekly worn. Harvard College gave him the degree of D.D. in 1835, and that of LL.D. in 1860. Yale College had given him the degree of LL.D. in 1853. In 1842 he was chosen a Fellow of this Academy, and in 1857 he was elected a member of the Massachusetts Historical Society. In 1854 he was made an honorary member of the Historical Society of Wisconsin, and, in 1859, an honorary member of the New England Historic-Genealogical Society. In 1860 the Senior Class in Harvard College requested him to sit for his portrait; and, in 1863, some friends had the privilege of seeing his grand head perpetuated in marble. The portrait by Hunt and the bust by Dexter are among the worthies which adorn the walls of the dining-room of Memorial Hall at Cambridge. The munificent gift of $12,000, presented to Dr. Walker by unknown friends in 1860, though not necessary to a man of simple tastes, and who had managed his affairs with a wise forecast, was, nevertheless, received by him with gratitude, as relieving him from all anxiety, and furnishing the means of increasing his facilities of study,

and, as he hoped, his usefulness. With great delicacy of feeling he preferred to interpret the gift as not wholly personal to himself, but as a recognition of the claims of the highest education upon the wealth which it helps to create; and, accordingly, by his own bequest to the library of Harvard College, he has given permanent significance to the generosity of his friends, and secured for them, as well as for himself, the gratitude of future generations of scholars.

It is a beautiful spectacle to contemplate a man, at the age of sixty-six, looking forward to freedom from anxiety it is true, but not to his ease and comfort; rather to continued study and usefulness. No official station could have added to the influence which he continued to exert over others, younger and more active than himself, and through them upon the community. Time added but slowly to his bodily infirmities, while it mellowed the fruits of his rich character, and left untouched his noble intellect. Though he had made few journeys, he knew what was in man, from history and his own reflection, better than others who had traversed continents; and, therefore, he was the most sagacious of counsellors. Surrounded by friends and neighbors who loved him, trusted by the wise, and in full sympathy with the young, his old age was as happy as it was serene and beneficent. No other words can more fitly express the beauty and the completeness of such a life than those inscribed upon the cup and salver which were presented to him on his eightieth birthday. "Thine age shall be clearer than the noonday. Thou shalt be as the morning" Not many weeks had passed after this commemoration when organic complaints, which had long threatened, assumed an alarming magnitude. His frequent visits to the college library were discontinued. He felt from the first that he should never recover the ground which he had suddenly lost. Possibly he might linger into the spring, and be able to walk or sit in his garden. For many years it had been a great pleasure for him to watch the never-failing miracle of the opening flowers. He made especial provision for the coming season, thinking that, if he lived, this recreation at least might remain to him. But the bulbs which he caused to be planted will blossom over his grave. His disease rapidly reduced his strength; but he continued, with great courage, to dress himself and pass the day in his study, until within a week of his death. When he was assured that the final summons had come he met it, as he had helped so many others to meet it, with the peace and hope of a Christian. He died on the 23d of December, 1874.

JEFFRIES WYMAN.

JEFFRIES WYMAN was elected a Fellow of the Academy in 1843. In 1855 he was made a Councillor in Class II., and continued to serve the Academy in this capacity until the Annual Meeting previous to the sudden close of his useful life on the 4th of September last.

At the time of his birth, Aug. 11, 1814, his parents were residing in Chelmsford, Mass., where his father was a practising physician. The latter, Dr. Rufus Wyman, was born in Woburn, Mass., and was a graduate of Harvard in the class of 1799. His mother was Ann Morrill, of Boston. Jeffries, who was the third son, was named for his father's friend, Dr. John Jeffries, of Boston. When he was but four years old, his parents moved to Charlestown, as his father had received the appointment of physician to the McLean Asylum for the Insane. Jeffries obtained the rudiments of his education at a private school in Charlestown, but soon entered the academy in Chelmsford where he remained until 1826, when he was sent to Phillips Academy in Exeter and was there fitted for college. Entering Harvard in 1829, he graduated in 1833 in a class of fifty-six, of which number Jeffries Wyman and five others were afterwards called to professorships in the University.

During his senior year in college he had a severe attack of pneumonia, which, probably, was the beginning of the pulmonary trouble that in after life became so serious an obstacle. His life was finally terminated by a sudden hemorrhage while he was at Bethlehem, New Hampshire, where he had gone to escape the autumnal catarrh with which he was affected when he remained in Cambridge during that period of the year.

Owing to his poor health he was often compelled to make distant journeys, in order to avoid the harshness of the New England climate. The first of these was to the Southern States, in the winter of 1833–34. Returning from this trip, he began the study of medicine under the direction of Dr. John C. Dalton, of Chelmsford, and his father at the McLean Asylum. Entering the Medical College in Boston, he was soon elected house-student in the Medical Department at the Massachusetts General Hospital. He received his degree of Doctor of Medicine in 1837, presenting as his thesis a treatise upon the eye, which, probably, was the basis of his first publication in the Boston Medical and Surgical Journal of September, of the same year, under the title of "Indistinctness of Images formed by Oblique Rays of Light."

Not finding a suitable opening for the practice of his profession, he

accepted the position of Demonstrator of Anatomy under Dr. John C. Warren, the Hersey Professor. During this period, when his very limited income made it necessary for him to secure in various ways the means of living, he became a member of the Boston Fire Department, under an appointment of Mayor Eliot, dated Sept. 1, 1838.

The foundation of the Lowell Institute, which was about this time put in active operation, and has since done so much in enabling scientists to follow their chosen paths, probably caused Jeffries Wyman, fortunately for science, to leave the ranks of the practising physicians, and devote his clear mind, sharp eye, and steady hand to original research. Accepting the position of Curator of the Institute, at the request of Mr. John A. Lowell, in the winter of 1840–41 he delivered a course of twelve lectures on Comparative Anatomy and Physiology.

In January, 1841, his first anatomical paper, "On the Cranium of a Seal," was communicated to the Boston Society of Natural History. Of this society he became a member about the time he took his medical degree, holding the office of Recording Secretary from 1839 to 1841, when, with the money earned by his course of lectures at the Lowell Institute, he started for Europe to continue his studies. He entered the Medical School in Paris in May, 1841, and attended the lectures at the Garden of Plants. When the lectures were completed, he made several pedestrian tours, and finally visited London, where he was engaged in studying the preparations in the Hunterian Collection at the Royal College of Surgeons when he was called home by the illness and death of his father. Resuming his residence in Boston and his active membership in the Boston Society of Natural History, he was soon elected a Fellow of the Academy, and in the same year, 1843, he accepted the chair of Anatomy and Physiology in the Hampden-Sidney College in Virginia, where he passed the following five winters, returning to Boston each summer. His first communication to the Academy was presented the same year of his election, and was on the anatomy of the electrical organs of the torpedo. During this year, which was one of the most fruitful of his life, he published about a dozen papers, principally communicated to the Natural History Society, besides delivering the annual address before that society. Among these papers was the first of an important series which, from time to time, appeared on the special anatomy of the apes, and also the first of his results upon minute anatomy, in which, with the assistance of his microscope, he afterwards did so much delicate and important work.

In 1847, he was appointed to succeed Dr. Warren as the Hersey

Professor of Anatomy at Harvard, which position he filled at the time of his death, though on account of his feeble health the college had relieved him from the duties of instruction for several years preceding, and, thanks to the thoughtfulness of the late Thomas Lee and the late Dr. W. J. Walker, his life from 1856 was made free from pecuniary difficulties, and his mind was relieved from the anxieties which narrow means had caused; but throughout all his trials he worked on with a cheerful, uncomplaining spirit, and, though not ambitious in the general acceptance of the term, he was always full of hope and faith.

On accepting the chair at Harvard, he at once began the formation of the perfect little Museum of Anatomy and Physiology, to which he added the results of all his anatomical work. Only once, during the several years of very frequent and cordial intercourse which the writer was so fortunate as to have with Professor Wyman, both in the laboratory and by the camp fire, was any thing heard from his lips that was contrary to his usual hopefulness; and this occurred after a protracted absence from his museum, when, going to a case to look up a special preparation he had made many years before, in order to illustrate a subject which had been brought to his notice, he pointed to a few preparations that had been misplaced during his absence and to the dust that had collected in the cases, and asked, in a grieved tone of voice, if there was any use in making anatomical collections, and if, after all, it was not work thrown away. He then instanced a once famous European Anatomical Museum, and said that during his last trip abroad he had hunted in vain for preparations which he had seen in their perfection during his first visit. "Then," he said, "the man who made them was alive, but on my last visit he had been dead several years." Let us trust that the gems, which he has left as examples of his delicate manipulation for the instruction of others, will receive the care in their new depository which he would have given had a similar collection been placed in his charge, when he was an active curator of the society which has assumed the trust.

Ever ready, in his quiet and faithful manner, to do his part towards advancing the interests of science, we find that Dr. Wyman was an active curator of the Boston Society of Natural History for many years after his return from his first European trip, and that he was continued as Curator of Comparative Anatomy during the time, and for several years after, he was President of the Society, which last office he held from 1856 to 1870, when the condition of his health was such that he could no longer take a constant part in the meetings, and he resigned his position.

He was, also, one of the original members of the American Association for the Advancement of Science, and its first Treasurer, having already acted as an officer of the older Association of Geologists and Naturalists. In 1857 he was elected President of the Association for the meeting to be held in Baltimore the following year, but he was not able to be present at that meeting.

On the establishment of the Museum of Comparative Zoölogy, he was appointed one of the faculty and continued in the position until the close of his life, which occurred soon after the death of the founder of the great museum, for whose unrivalled talents and enthusiastic nature, so directly the opposite of his own retiring disposition, Wyman always expressed the highest esteem. That his appreciation of Agassiz was thorough and free from all envy, which, perhaps, many another less noble and generous nature would have felt on seeing aid lavished by liberal hands on a sister museum when his own was retarded for the total want of means, is well exemplified by a remark he made soon after the death of the lamented Agassiz. After speaking in relation to the position which Agassiz had taken on the all-absorbing questions of natural selection and evolution, he uttered the following sentence in his usual simple, but earnest manner: "Well, say what we will as to his views, right or wrong, there is no mistake about it, Agassiz was head and shoulders above us all."

While attending to his duties in the college, and teaching the several private students who were so fortunate as to gain admission to his laboratory, he continued his researches, and, from time to time, communicated the results of his labors to the Natural History Society and to the Academy. Several of his papers were printed in the American Journal of Science and Art, and one of his most extended, that on the nervous system of *Rana pipiens*, was published in 1852 by the Smithsonian Institution in its quarto memoirs. The Journal and Proceedings of the Boston Society of Natural History contain many valuable papers communicated by him, among the most important of which is that on the Gorilla, printed in 1847, and followed by several papers in which the resemblances and differences between man and the ape are discussed with that care which is so apparent in all that he wrote. Another of his series of observations was first made known by his paper on the anatomy of the blind fish, published in 1843; and to this subject, as to that of the anatomy of the apes, he returned as opportunities offered. The most important of the communications made to the Academy are those on the "Development of the Skate," in 1864, and published in the Memoirs; and that

printed in the Proceedings for 1866, entitled "Notes on the Cells of the Bee."

In 1849 he gave a second course of lectures at the Lowell Institute, and with the means thus acquired he made a voyage to the coast of Labrador.

Professor Wyman married Adeline Wheelwright in December, 1850. The winter of 1852 he passed in Florida. In 1854, he travelled extensively in Europe, accompanied by his wife, from whom he was parted, by her death, in the following June.

The spring of 1856 found him with two students in Surinam, where he was prostrated by the fever of the country. Being still forced to make pilgrimages for his health, in 1858–59 he accepted the invitation of Captain J. M. Forbes and made a voyage to La Plata; and, after ascending the rivers Uruguay and Paraná, he crossed the continent with his friend, Mr. G. A. Peabody, and returned home by the way of Peru and the Isthmus.

In August, 1861, he married Ann W. Whitney, whom he had the misfortune to lose in 1864. By his first wife he had two daughters, and by his second a son, all of whom still survive.

On the foundation, by Mr. George Peabody, of the Museum of American Ethnology and Archæology at Cambridge, Professor Wyman, who was named as one of the seven trustees, was at once requested by his fellow-members of the board to take charge of the Museum as its Curator. These new duties drew him, in part, away from general anatomical and physiological researches into a special field, upon the margin of which he had often trod in his earlier investigations, and we find him devoting his time, from this period, principally to anthropological studies. His immense knowledge of comparative anatomy proved of very great advantage in these new studies, while his predilection for human anatomy found sufficient opportunities for its indulgence. Being obliged to spend his winters in Florida, he had opportunities to investigate the ancient shell-heaps which are so extensive there; and to a person of Wyman's peculiar powers and careful research these prehistoric remains could but prove most instructive.

From the study of these, and from the examinations of many shell-heaps of a similar character along the Atlantic coast, especially of Maine and Massachusetts, he was able to draw many interesting conclusions. The early results of his labors in this field are given in two papers in the American Naturalist for 1867–68. A more extended memoir on the shell-heaps of Florida was completed but a short time

before his death, and embodied the results of his work during the preceding winter, among the most important of which was the determination of the fact of cannibalism among the early race who formed the heaps in Florida. Proofs of the first pages of this memoir had passed through his hands in revision; and, thanks to his usual care in the preparation of his papers, the memoir was fully written, and will in time, be given to the world as his latest work.

The seven Annual Reports on the condition and accessions to the New Museum are evidences of what he did in connection with the Museum. He also communicated to the Natural History Society several important papers, the results of anthropological studies, one of which, entitled "Observations on Crania" and printed in the Proceedings of the Society for 1868, is a most instructive review of the characters exhibited by a large number of crania, and is interesting in showing how carefully he made his deductions. During the winter of 1869–70, he visited Europe for the third time, partly in the interests of the Archæological Museum, combined with the hope that his health would be benefited by the change. The following winters he passed, as before, in Florida, and every spring returned to his labors with his strength temporarily renewed.

In this short and imperfect outline of the life of our late associate, no attempt has been made to portray his noble character or to dwell upon his many virtues. Neither has justice been done to his numerous papers and memoirs. To do this as it should be done would far exceed the limits which custom has established for these notices. Loving hearts and able minds have justly recorded his many contributions to science, and have made known to the world his manly and upright traits, his strength of mind, and his noble character.*

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* The following extended notices of the life and works of Jeffries Wyman have come under our observation, in addition to a number of notices in the daily press and in several magazines at the time of his decease, besides resolutions passed by various bodies, generally accompanied by short notices.

By Prof. Asa Gray. A sketch of the Life of Jeffries Wyman, read at the Memorial Meeting of the Boston Society of Natural History, Oct. 7, 1874, and published in the *Proceedings* of the Society.

By Prof. Oliver Wendell Holmes. A Memorial Outline. *Atlantic Monthly*, November, 1874.

By Prof. Burt G. Wilder. A Notice of Dr. Jeffries Wyman. *Old and New*, November, 1874.

By Prof. Burt G. Wilder. Sketch of Dr. Jeffries Wyman, with a portrait. *Popular Science Monthly*, January, 1875.

By Dr. S. Weir Mitchell. The Scientific Life. *Lippincott's Magazine,* March, 1875.

By Prof. Asa Gray. A Notice of Jeffries Wyman. *Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology for* 1874. April, 1875.

A List of Communications of Prof. Wyman to the Boston Society of Natural History.

1. Jan. 20, 1841, On the Cranium of a Seal.
2. Jan. 4, 1843, Echinorynchus nodosus.
3. Feb. 1, 1843, Rotifer and Tardigrade Animalcules.
4. Mar. 1, 1843, Linguatula from a Boa.
5. Mar. 1, 1843, Ascarides from Cyclopterus.
6. April 5, 1843, Anal Pouch of Mephitis.
7. July 5, 1843, Analogies of the Teeth of Lepidostei and Labyrinthodonts.
8. (With Dr. T. S. Savage) ——, 1843, Organization of Troglodytes niger.
9. Nov. 15, 1843, Anatomy of Tebennophorus Carolinensis.
10. Nov. 15, 1843, Anatomy of Glandina truncata of Say.
11. Sept. 4, 1844, Spongia fluviatilis.
12. Nov. 15, 1843, Description of a New Species of Torpedo.—American Academy of Arts and Sciences, April 25, 1843.
13. May 17, 1843, Annual Address.
14. Sept. 17, 1845, On Two Species of Linguatula.
15. Nov. 5, 1845, On the Fossil Skeleton of Hydrarchos Sillimani.
16. (With Prof. Jas. Hall), May 20, 1846, On Castoroides Ohioensis.
17. June 20, 1846, Anatomical Description of Cranium of Castoroides Ohioensis.
18. Aug. 18, 1847, On Troglodytes Gorilla.
19. (With Dr. T. S. Savage) Dec. 18, 1847, Osteology of Troglodytes gorilla.
20. Nov. 7, 1849, On the Arrangement of Fibres in the Cancellated Structure of some of the Bones of the Human Body.
21. Aug. 20, 1851, On the Brain and Spinal Cord of the Lophius Americanus.
22. Nov. 5, 1851, Anatomy of Carcharias obscurus.
23. Sept. 20, 1854, On the Development of Anableps Gronovii.
24. April 18, 1855, Measurements of the Internal Capacities of four East Indian Crania.
25. Oct. 17, 1855, On the Footprints discovered by Prof. Henry D. Rogers in the Carboniferous Strata of Pennsylvania.
26. Nov. 21, 1855, Account of the Dissection of a Black Chimpanzee.
27. Sept. 3, 1856, Electric Apparatus in the Tail of the Raia lævis.
28. Oct. 1, 1856, Account of Fossil Bones collected in Texas.
29. Sept. 3, 1856, On the Poisoning Powers of a Living Rattlesnake upon a Mouse.
30. Oct. 15, 1856, On the Morphology of the Urinary Bladder of Batrachians.
31. Dec. 3, 1856, Anatomy of the Blind Fish of the Mammoth Cave.
32. Jan. 21, 1857, On the Dissection of the Eye of a Sperm Whale.
33. Sept. 16, 1857, Species of Fishes from the Surinam River.
34. Nov. 18, 1857, On the Development of Anableps Gronovii, as compared with that of the Embiotocas of California.

35. Dec. 16, 1857, Examination of the Bagre.
36. Dec. 17, 1856, Memoir of the late President, Dr. John C. Warren.
37. Feb. 3, 1858, Account of the Dissection of a Human Fœtus.
38. April 7, 1858, Results of some Examinations of a Large Number of Fœtal Pigs.
39. May 19, 1858, On the Formation of the Egg-case of Skates.
40. June 2, 1858, A Cyclopean Pig.
41. Sept. 1, 1858, On several Parasites found in the American Deer.
42. Sept. 15, 1858, Remarks on the Death of Dr. Francis W. Cragin, a Corresponding Member of the Society.
43. Oct. 19, 1859, Account of some Observations on the Shedding of the Antlers of the American Red Deer.
44. Jan. 4, 1860, Account of the Gorilla Collection of Mr. Du Chaillu, in New York.
45. April 18, 1860, On Two Parasites.
46. May 16, 1860, On the Poison Apparatus of the Rattlesnake.
47. Sept. 19, 1860, On a Fossil from the South-west Frontier of the United States.
48. Feb. 20, 1861, A partially double Pig.
49. Mar. 6, 1861, On the Mode of Formation of the Rattle of the Rattlesnake.
50. August, 1861, On the Presentation to the Society by Dr. William J. Walker, the Estate recently occupied by him.
51. Oct. 2, 1861, On Bones of a Gorilla recently obtained in Western Equatorial Africa.
52. Nov. 20, 1861, A Preparation of the Bones of a Supernumerary Leg from a Goose.
53. April 2, 1862, Dissection of a Hottentot.
54. May 22, 1862, Experiments on Minute Living Organisms.
55. Sept. 17, 1862, On Larvæ of Dactylethra Capensis.
56. Sept. 17, 1862, On Reproduction of Lost Parts in Planaria.
57. Oct. 15, 1862, On Eggs of Salamanders.
58. Oct. 15, 1862, On a Remarkable Case of Poisoning.
59. Nov. 19, 1862, Recent Observations on Pentastoma.
60. Dec. 3, 1862, On Development of Human Embryo.
61. Jan. 21, 1863, On Two Cases of Monstrosity in Serpents.
62. Feb. 18, 1863, Observations on the Cranium of a Young Gorilla.
63. Mar. 18, 1863, On a Cyclopean Pig.
64. April 1, 1863, On the Mechanism of the Tibiotarsal Joint in the Ostrich.
65. April 15, 1863, On the Structure of Beluga.
66. April 15, & May 20, 1863, Description of a "White Fish" or "White Whale."
67. May 20, 1863, On Localization of Species.
68. June 3, 1863, On the Sea-serpent.
69. June 17, 1863, On Mode of Impregnation of the Ova in Pomotis.
70. Sept. 16, 1863, Observations on Amœba.
71. Nov. 18, 1863, On the Development of Raia batis.
72. Dec. 2, 1863, On Amphioxus.
73. Dec. 16, 1863, On the Skeleton of a Hottentot.
74. May 18, 1864, & Feb. 1, 1865, Development of Mould in the Interior of Eggs.

75. June 1, 1864, On Reptilian Bones from New Red Sandstone at Middlebury. Conn.
76. Oct. 19, 1864, On Malformations.
77. Nov. 2, 1864, On Indian Mounds of Atlantic Coast.
78. Feb. 1, 1865, On Accommodation of the Eye.
79. Feb. 1, 1865, On the Power of Vibrio, &c., to resist Action of Boiling Water.
80. Mar. 15, 1865, On Fossil Mammalia from the Andes of Peru.
81. Sept. 20, 1865, On the Formation of Ripple Marks.
82. Nov. 15, 1865, On the Irregularities noticeable in Cells of the Hive-bee.
83. Nov. 15, 1865, On the Human Arterial System.
84. Jan. 17, 1866, On the Reproduction of Lost Parts in Animals.
85. Jan. 17, 1866, On the Hexagonal Cells of Bees.
86. June 20, 1866, Dissection of a Young Pigeon.
87. Oct. 17, 1866, On the Distorted Skull of a Child from the Hawaiian Islands.
88. Nov. 14, 1866, On the Morphology of the Leaves of Sarracenia.
89. April 17, 1867, Account of the Shell Mounds of Florida.
90. May 1, 1867, Account of the Life and Scientific Career of Dr. A. A. Gould.
91. May 15, 1867, Description of the Shell Heaps at Salisbury.
92. June 5, 1867, On Symmetry and Homology in Limbs.
93. Sept. 18, 1867, Destruction of a Male Spider by the Female.
94. Sept. 18, 1867, Account of a Visit to an Indian Shell Heap near Mount Desert, Me.
95. Oct. 2, 1867, On Flint Implements from Northern Europe
96. Oct. 2 & 16, 1867, Shell Heaps on Goose Island.
97. Nov. 20, 1867, Measurements of some Human Crania.
98. Dec. 4, 1867, Examination of the Animals of the New England Shell-Heaps.
99. Jan. 15, 1868, On the Occurrence of Eels in the Abdominal Cavity of the Cod.
100. April 15, 1868, Observations on Crania.
101. Oct. 7, 1868, On a Thread Worm infesting the Brain of the Snake Bird.
102. Dec. 2, 1863, On the Inscription of the Dighton Rock.
103. Dec. 16, 1868, On Nautilus pompilius.
104. May 19, 1869, On the Head of a Crocodile, C. Acutus, obtained in the Miami River.
105. May 20, 1874, Remarks on Cannibalism among the American Aborigines.

Papers contributed to various Journals.

106. On the Indistinctness of Images formed by Oblique Vision. — Boston Medical and Surgical Journal, September, 1837.
107. Review of Embryologie des Salmones; par C. Vogt.
108. Description of a New Torpedo. — American Academy of Arts and Sciences.
109. Notice of Remains of Vertebrated Animals found at Richmond, Va.
110. Twelve Lectures on Comparative Anatomy. — Lowell Institute, January and February, 1849.
111. Cranium of Manatee. — American Journal of Sciences and Arts, Second Series, Vol. II.

112. Fossil Bones from the Neighborhood of Memphis, Tennessee.
113. Effect of the Absence of Light on the Development of Tadpoles. — April, 1853.
114. Critical Notice of the Zoölogy of New York.
115. Critical Notice of Echinodermes Vivans et Fossiles, par L. Agassiz.
116. Description of the Post-mortem Appearances in the Case of Daniel Webster. — American Journal of Medical Science, January, 1853.
117. On the Eye and Organ of Hearing in the Blind Fishes of Mammoth Cave. — American Journal of Science and Arts, March, 1854.
118. Cranium of Mastodon Giganteus and the Form of the Brain.
119. Observations on the Development of the Surinam Toad, 1854.
120. Description of a Carboniferous Reptile. — Dendrerpeton Acadianum, Nova Scotia.
121. On some Unusual Modes of Gestation.
122. Remains of Batrachian Reptiles found in the Coal Formation of Ohio.
123. Observations on a Species of Hornet (Vespa) which builds its Nest in the Ground.
124. Description of some Instances of Nerves passing across the Middle Line of the Body.
125. Description of an Anencephalous Fœtus with Unusual Malformation. — Boston Medical and Surgical Journal, June, 1866.
126. Notice of Observations on the Respiration in the Chelonia, by S. Weir Mitchell, M.D., and George N. Morehouse, M.D.
127. Notice of Richard Owen's Monograph of Aye-Aye, with Remarks on the Origin of Species.
128. Description of a Double Fœtus, with Remarks on the Resemblance of Polar Forces to those governing the Distribution of Matter in the Embryo.
129. Account of some of the Kjoekkenmoeddings or Shell Heaps of Massachusetts.
130. Rana Pipiens (nervous system). — Smithsonian Contributions to Knowledge.
131. Raia Batis, (skate) Embryology.
132. Seven Successive Reports of the Peabody Museum of American Archæology and Ethnology, 1867 to 1873.
133. Description of the Shell Heaps of St. Johns River, East Florida.
134. Observations and Experiments on Living Organisms in Heated Water. — American Journal of Science and Arts, September, 1867.

FRIEDRICH WILHELM AUGUST ARGELANDER.

Friedrich Wilhelm August Argelander was born at Memel, in Prussia, March 22, 1799, and died at Bonn, Feb. 17, 1875, nearly seventy-six years old. He began his professional career as Privat-Docent in the University of Königsberg, and assistant (to Bessel) in the famous observatory of that place; while there he made many calculations of value, and assisted Bessel in his zones. He was especially noted even then for his skill in handling instruments "like a glove," Bessel says, in his letters to others. In 1825 he became director of

the observatory of Åbo, in Finland; after the great fire there the University was removed to Helsingfors, and Argelander, with the instruments of the observatory, went too. His work at Abo was chiefly devoted to his famous catalogue of 560 stars; a model catalogue, which is yet unsurpassed for convenience and accuracy. The work was completely reduced, and published at Helsingfors. This same material enabled him to fix, with accuracy, the direction in which the sun is moving, as surmised by Sir William Herschel and others.

In 1837 he removed to Bonn. The four years succeeding, as he had no observatory, were given to his Uranometria Nova, the first attempt at a delineation of an exact star-map for naked-eye observers; and a most admirable work it has proved to be. He laid down upon the map about forty stars not previously observed even with the telescope.

In 1841 a temporary shed was fitted up for a transit-instrument and clock. By adding a divided arc to the transit he was able to get accurate delineations, as well as right ascensions, of about 26,000 stars, continuing Bessel's zones to 80° of north declination.

When the observatory was finished and provided with instruments, he continued the same zones from 15° to 31° of south declination; it is this work which our colleague, Dr. Gould, is now continuing still farther south.

After this work was completed, the great survey of the northern heavens, on a still more minute scale, followed. The maps and rough plans of all stars to the magnitude 9.5 north of 2° of south declination came out some ten years ago; since that time he has published many thousands of accurate observations, partly to solve doubts in the other work, partly for the study of proper motions. There is yet a volume of these investigations unpublished. The seven published volumes of Bonn observations contain these zones, the calculations of proper motion for four or five hundred stars, his observations on variable stars, and a very valuable series of errata to the principal star-catalogues.

He was remarkable for his skill in detecting errors in the older observations; and his account of the curious mistakes into which his rapid and impatient master Bessel occasionally fell, when the slower Busch was a little tardy in reading microscopes, is quite amusing. And in another place his detections of the peculiar errors committed by Lalande and his friends, in reading off their numbers aloud in French, is also entertaining.

Argelander was the promoter of the scheme now in progress for a

still more accurate catalogue of the stars to be made, by a combined effort of astronomers in the principal countries of the civilized world; and his directions for making these observations are a masterpiece of practical astronomy.

Argelander's position as an astronomer is a most elevated one; he was not a deep mathematician, but in his specialty, stellar astronomy, surpassed all save Bessel and Wilhelm Struve. His works must be thoroughly studied by any one who wishes to attain to any eminence in the same studies. They are almost absolutely faultless; and the keenness of his criticism of others is everywhere made doubly effective by the gentleness and kindness of his tone, and his care never to omit giving due commendation to the same works. The founders of the modern German school of practical astronomy — Bessel, Gauss, W. Struve, Argelander, Encke, Schumacher, Hansen — are now gone from us; it remains for their disciples, of all countries, to worthily perpetuate their memory.

ÉLIE DE BEAUMONT.

Élie de Beaumont, who died on the 24th September, 1874, was born on the 25th of the same month, 1798, and entered the École Polytechnique of Paris in 1817, from which he passed to the École des Mines, which was to be his field of labor for a long lifetime, and with the reputation of which his name will always be associated. While yet a student, he gave proof of a rare intelligence and a great devotion to geology, which led to his early selection for what proved the chief work of his life, the preparation, in conjunction with Dufrénoy, of a geological map of France, for which that of England by Greenough, published about this time, was to serve as model. Having completed his studies in 1822 and joined the corps of mining engineers, he was with Dufrénoy sent to England to get suggestions as to the work, and also to collect statistics of the mining industry of the United Kingdom. It was not till 1825 that the task of the map was commenced, a work which required eighteen years for its completion. This map, with its accompanying volumes of text, remains a great monument to its authors and a work of national importance, not only by reason of the services which it has rendered to the science of geology, but for the aid given to the development of the country in every industry connected with the earth's crust, from mining to civil engineering and agriculture. In this great task Élie de Beaumont was aided by his colleague Dufrénoy, but his labors in connection with the geology of

France did not cease with its publication; for the government, having subsequently decreed the preparation of a more detailed geological map, the direction of this work (of which the first portion was published in 1874), was confided to De Beaumont. Even when in 1868 he was obliged by the rules of the service to resign his place as inspector-general in the corps of mining engineers, he was still retained as director of the detailed geological map, a duty with which he was occupied up to the time of his death. Besides these official duties in connection with his profession, he succeeded in 1835 his old master Brochant de Villiers as professor of geology at the École des Mines, having already in 1832 been called to fill what was then the only chair of natural history in the Collége de France, left vacant through the death of Cuvier. Making this a chair of geology, he became the great teacher of the science in France, and during twenty years gathered around him students from every land, who learned to recognize in Élie de Beaumont the founder of a school. His "Leçons de Géologie Pratique," given at the Collége de France in 1843, and his "Notice sur les Systèmes de Montagnes" in 1852, resume the greater part of his teachings.

Élie de Beaumont early adopted the theory of elevation-craters of Von Buch, which, not confining to volcanic mountains, he extended to mountain chains in general, these being, according to him, connected with eruptions of plutonic rocks, and having been thrown up in successive ages by violent and paroxysmal movements. All the lines of fracture and elevation of the same date were supposed by Élie de Beaumont to be parallel to a great circle of the earth, thus giving the basis for a classification of mountains. The relative dates of these phenomena he endeavored to fix by considering the respective ages of the disturbed strata and the horizontal ones around them, thus determining the age of the various mountain chains. Finally, he attempted to show a geometrical co-ordination of the mechanical forces which had thus disturbed the earth's crust, and conceived that the lines of the various systems of elevation were so arranged as to form a pentagonal network or *réseau pentagonal.* His studies on mountain systems, begun in 1829, were continued with zeal up to the last years of his life, involving great labors in the field and an enormous amount of trigonometrical calculation; but his conclusions are rejected by most of the geologists of the present time.

In 1847 appeared his remarkable essay Sur les Émanations Volcaniques et Metallifères, in which, bringing to bear on the subject his wide knowledge of chemistry and of mineralogy, Élie de Beaumont proceeded

to discuss the whole theory of mineral waters, metalliferous deposits, and volcanic products, and to show the relations between these apparently unlike classes of phenomena. He here gave the weight of his great authority to the then novel doctrine of the aqueo-igneous fusion of granites, and thus did much to advance the modern notions with regard to eruptive rocks which are displacing those of the older plutonic school. This essay will remain a landmark in the progress of chemical geology, and one of its author's most important contributions to his favorite science. On the other hand, his conclusions with regard to the geology of the Alps, and especially with regard to the anthracite formation of that region and the supposed conversion of mesozoic strata into crystalline rocks, have been rejected by recent investigators, and the results of the study of the Mont Cenis tunnel are held by many to have demonstrated their inaccuracy.

Élie de Beaumont was for nearly forty years member of the section of geology and mineralogy in the Académie des Sciences, of which he became one of the perpetual secretaries as a successor to Arago. On the creation of the senate he was made a Senator of the Empire, and he was raised to the dignity of Grand Officer of the Legion of Honor.

In his various relations, both public and private, the character of Élie de Beaumont was marked by purity, elevation, and a religious conscientiousness which commanded the highest respect. If in his later years he became somewhat impatient of contradiction when his peculiar views were called in question, he was a kind friend, a generous encourager of youth, and full of a delicate and unostentatious benevolence which endeared him to all those who, like the writer, had the advantage of knowing him personally. He was a great favorite with students, and to the last year of his life esteemed it a privilege to accompany the pupils of the École des Mines in their geological excursions. Élie de Beaumont's strong sense of duty and of patriotism was shown in the dark days of the late siege of Paris. Though urged by his friends to fly, he declared his intention to remain faithful to his post of perpetual secretary to the Academy, and neither the terrors of the bombardment nor of conflagration could disturb his fixed purpose, nor interrupt his nightly and severe studies. He married late in life a woman in every way worthy of him; but their union was of but few years' duration, and she died leaving him no children. His life was long, happy, and honorable; and his name will remain as one of the great scientific glories of France.

SIR WILLIAM FAIRBAIRN.

Sir William Fairbairn was born at Kelso, in Scotland, on the 19th of February, 1789. His father was Andrew Fairbairn, a farmer in humble circumstances. His early education was therefore very meagre; but the mechanical genius which distinguished him in after life showed itself on several occasions while he was yet a boy. At the age of sixteen he was apprenticed to the Percy Main Colliery Company, with wages at eight shillings per week, which he was enabled to increase by overwork. His duties were mainly in the engineering department of the works. What he learned here practically, he supplemented by a regular course of study in the evenings. Every evening of the week had its appointed work, — Mondays, arithmetic and mensuration; Tuesdays, history and poetry; Wednesdays, recreation, novels and romances; Thursdays, algebra; Fridays, geometry and trigonometry; Saturdays, recreation. His persistent efforts, aided by great natural ability, enabled him to remedy in great part the want of early training.

At the age of twenty-one he went to London in search of work, and remained there about two years. Thence he worked his way through the south of England and Wales to Ireland, remaining in Dublin, at the Phœnix Foundry, about six months. In 1814 he made his way to Manchester; and, after working there about two years as a journeyman millwright, he commenced business for himself, in connection with a shopmate, James Lillie, — a partnership that continued fifteen years. His specialty was mill-work; and he soon made such improvements in the machinery of mills that his success in life was at once assured. Here he began the introduction of wrought iron as a building material; and to his persistency and success in its use is due much of the credit of the subsequent rapid increase of the employment of wrought iron in machinery, bridges, and ships. In 1831 he built a small iron vessel, one of the first constructed; and its success was so great that he established in 1835 the extensive works for iron ship-building at Millwall on the Thames, where, in the next fourteen years, he built about one hundred and twenty iron ships, some of which were of very large size.

When Robert Stephenson was engaged upon the designs for the Conway and Britannia bridges, Mr. Fairbairn, in connection with Mr. Hodgkinson, made an elaborate series of experiments to determine the best form of tubular girders, and thus contributed materially to the success of those works. These experiments, and others upon solid and built iron beams, upon riveted joints, the properties of cast iron, col-

lapsing tubes, and steam-boilers, have been highly appreciated by engineers. Many valuable papers on these and other subjects in mechanical engineering were published by him in the British Association Reports, the Transactions of the Royal Society, of the Institution of Civil Engineers, and of the Philosophical Society of Manchester.

Among Mr. Fairbairn's works may be mentioned: "Mills and Millwork," "Canal Steam Navigation," "The Application of Iron to Building Purposes," "Iron Ship Building," "The Strength and other Properties of Hot and Cold Blast Iron," "The Strength of Locomotive Boilers," "The Iron of Great Britain," "The Strength of Iron Plates and Riveted Joints," "The Strength of Hollow Globes and Cylinders exposed to Pressure from without," "The Cohesive Strength of Different Qualities of Iron and Stone," "The Strength of Iron at Different Temperatures," and "Useful Information for Engineers."

Mr. Fairbairn received many honors in recognition of his valuable labors. He was a Fellow of the Royal Society and of the Academy of Turin, a Corresponding Member of the Institute of France, and a Member of the Institution of Civil Engineers and of Mechanical Engineers. He was elected a Foreign Honorary Member of this Academy in 1862. He received the degree of LL.D. from the Universities of Cambridge and Edinburgh. He was made a Chevalier of the Legion of Honor, and was created a Baronet in 1869.

He died at Moor Park, the residence of his son, Aug. 18, 1874.

FRANÇOIS-PIERRE-GUILLAUME GUIZOT.

François-Pierre-Guillaume Guizot was born at Nîmes, Oct. 4, 1787, and died Sept. 12, 1874. Thus his long life of eighty-seven years stretched over the series of revolutions through which France has passed in a century. His father was guillotined in 1794, and he himself became an exile in 1848. He soon returned to his native country, and for a quarter of a century was a witness of its latest experiments and vicissitudes, but no longer a leader or even an actor in them.

Guizot received his education at Geneva, whence he removed to Paris in 1805, to enter upon close and severe study, which soon bore fruit and brought him into notice. One of his early undertakings was an annotated edition of Gibbon's "Decline and Fall of the Roman Empire," — a labor which helped to equip him for his distinguished treatment of the same subject many years afterwards. Before the fall of Napoleon he was made Professor of Modern History in the Faculty

of Letters at Paris. Under the Restoration he entered into political life, and at different times held administrative offices. He was an important member of the school or class of politicians known as "doctrinaire," which began with taking a middle position between extreme legitimists and advanced liberals. As a publicist and a scholar he was an active writer, and his professorial lectures excited great interest. At length, however, having given umbrage to the reactionary government, which had come into power in 1820, they were suspended in 1822.

During this suspension Guizot was not inactive. In 1823 he published a great Collection of (translated) Memoirs relating to the history of the English Revolution, with prefatory notices. This served as a sort of prelude to a series of histories, of which the first two volumes appeared in 1827. He edited also an extensive Collection of Memoirs relating to the history of France, with introductions and notes of his own. This, too, like his edition of Gibbon, was turned to good account in his subsequent lectures. Various other writings of his appeared in this interval.

In 1828 Guizot's suspension was taken off, and he delivered in that year and the next two years, at the Sorbonne, three courses of lectures, which were received at the time with marked applause, and have been celebrated for their skilful analysis and comprehensive generalization. They have been widely read, under the often published titles of History of Civilization in Europe and History of Civilization in France. The author, however, had no opportunity to do perfect justice to his plan. His lectures were suddenly broken off by the revolution of 1830, which transferred him to the political arena. The latter work stands now where it was arrested then.

Guizot had been returned before the height of the crisis to the Chamber of Deputies, and he soon took an active interest in the establishment and organization of the new government. In time he became a great parliamentary speaker, and at last the foremost political figure in France. As Minister of Public Instruction he was the framer of important laws, and finally as virtual or as formal head of the ministry directed, for several years, — with his royal master, who was not quite content to reign without governing, — the public affairs of France. When the revolution of 1848 surprised and overthrew him, he found a temporary refuge in England, where he had formerly been well known as ambassador. After the storm had blown over, he returned to France, and there ended his political career with an unsuccessful canvass for a seat in the Chamber.

The revolution of 1848 restored Guizot to literature. He took up

again and carried forward his history of the English Revolution; he composed and issued several volumes of Memoirs relating to his own time; he collected and edited his parliamentary speeches; and he published or republished other writings, — among them, some volumes of Meditations on the Christian religion. His political sceptre was broken; but in the elect circle of the French Academy (of which since 1836 he had been a member) he found room to exert the controlling will that the changing fortunes of eighty years had not been able to break; and in the Protestant Consistory he led with characteristic energy the opposition to the latitudinarian tendencies of the day.

Guizot's last years were spent mostly in his country home at Val Richer in patriarchal and dignified simplicity. The traits of his character shone in the light of old age. One of his last interests was "the paternal pleasure of relating the history of France," as he said, "to my grandchildren," — with no view, however, to publication. This narrative he lived to carry a great deal lower than the period covered by his lectures on the history of Civilization in France. When publication was asked and granted, he took formal occasion to affirm his historical creed by emphasizing what he deemed the two factors of all history: "L'histoire a des lois qui lui viennent de plus haut; mais les hommes sont, dans l'histoire, des êtres actifs et libres, qui y produisent des résultats et exercent une influence dont ils sont responsables."

SIR CHARLES LYELL.

Fortunate alike in his genius and his circumstances, Sir Charles Lyell was one of the few eminent cultivators of modern science who had not lived to see in his old age the work of his youth and his prime superseded or surpassed in the rapid advance in the knowledge of nature that distinguishes our time. Entering on his career at a period when every thing was prepared for the impulse of a master-mind, he determined that movement of progress in geology which is one of the greatest achievements of our century; and throughout a long life he maintained that position of direction and command to which his superior sagacity guided him at an early age, and which his superior ability secured. The influence of Bacon's teaching, which related rather, or more directly in effect, to the social and religious standing or respectability of scientific pursuits and theories, than to any real guidance in scientific method, had prepared the world, and especially the English-speaking world, for that consideration of heterodox views, and that toleration of novelties in science, with which the last century

ended. The physical sciences had just made a wonderful advance from the impulse first given about two centuries before by the genius of Galileo. The fierce disputes of the eighteenth century about geological hypotheses had nearly died out. These hypotheses had, at least, ceased to be regarded by the best minds as dogmas to be opposed or defended, and had come to be considered in the light of questions put to nature; to be decided only by that patient thoughtfully directed labor of research in which an army of explorers became engaged and which they still pursue. Genius, in such circumstances and with such co-operation, does not stand forth in history with so conspicuous an eminence as when appearing alone or in conflict with the prejudices of its times. That feature of genius, energy of will and character, which strikes us most in its most conspicuous examples, is thus made to appear to be its leading characteristic. The subtlety of perception, the sagacity or wisdom, which guides the energies of genius, and is their determining motive, appears thus in an illusively disproportionate degree. Though less conspicuously, therefore, than many other names in science, yet not any less inseparably connected with its advance, is the name of Sir Charles Lyell associated with the progress of a great revolution in geology.

The separation of geological questions from scholastic disputes, and the establishment of the science as a strictly inductive one, are in a great measure to be credited to the early, clear, and steady conception of true method, which Sir Charles Lyell's works expounded, and were admirably designed to promulgate. For more than forty years they have been the text-books of the progressive school of geology; keeping pace in their successive editions with the progress of the science, and being thus, as it were, compends of its history. The "Elements of Geology," of which seven editions were published, the last in 1871, was a strictly descriptive treatise in accordance with the principles of Baconian induction. But not so his masterpiece, the "Principles of Geology." So far from being of a Baconian type, this work takes its form and spirit from the genius of Galileo. Of modern students of nature whose preparatory training has not included an adequate discipline in mathematical and experimental research, many have committed the error of extending their dislike of the *a priori* and deductive methods of scholastic philosophy, and of more ancient explanations of nature, to all use of deduction in natural science. But the *axiomata media* of Bacon, the middle principles, which constitute in any science its characteristic value, are vainly sought, except in the most abstract sciences, by the direct Baconian methods of induction. They are

really derived deductively, though only after the broader principles have been independently established by induction. But this can be safely done only after the lowest or merely descriptive generalizations have presented the problems and the tests, between which and the highest generalizations explanatory connections are sought by the deductions and verifications of physical science.

A far more intimate actual acquaintance than Bacon even dreamt of with the principles of physical causation had been attained in dynamical science, and was familiar to many students of geology during the eighteenth century; principles which are almost as remote from the science of Bacon's time as from that of Aristotle's. These principles, and the examples of their application to the explanation of natural phenomena, gave a direction to the inquiries of geologists which was naturally enough looked upon as rash in speculation, and even irreverent in spirit, by all who did not share in the insight of these thinkers. The possibility of explaining the phenomena of the earth's formations by means of the causes in actual and normal operations, and not any disrespect for miraculous causes, but a preference for the explanations which to their trained imaginations appeared possible, "without violence, without fictions, without hypotheses, without miracles," determined the theories of the uniformitarians, and especially those of Hutton and his school. The very conception of geology as a branch of physical science, and as allied with Newtonian astronomy, physical geography, and meteorology, divided it sharply from the cosmological speculations which, without foundation in inductions, had previously served as principles of explanation in this science. Hutton was the first to declare that geology is in no wise concerned with questions as to the origin of things. But the very name "origin" had to be converted from its familiar absolute meaning, as a synonyme of miraculous creation, to its meaning in modern science, that of natural production. The revolution about to take place in geology was first clearly apparent to those thinkers who were familiar with and trained in the applications of dynamical principles to the explanation of natural phenomena, not only in the regularities and recurrences of these phenomena, but also in the gradual changes, and the progressions in their conditions, which these principles implied. Playfair's illustrations of Hutton's theories were studies undertaken in the spirit of this philosophy. But as yet the lower and merely descriptive facts of the science were far too few and incomplete to afford definite problems or decisive tests of theory. Playfair's work was published in 1797, the year in which Lyell was born. Ten years later, in 1807, the Geological Society of London

was founded. This, like other modern scientific societies, was devoted to the Baconian cultivation of science, or to furnishing a broad inductive basis for the future constitution of geology, and was principled against the premature speculation of the middle principles and explanations of the science. In this society no discussions of "theories of the earth" were in order.

But there already existed a body of facts in the current physical history of the globe, bearing on questions of origin, which needed only to be revised and augmented to serve for subsequent legitimate deductions in geology. The genius of Lyell was first turned to this field of research; and in the year 1832 the first fruits of his labor appeared in the earliest edition of his "Principles of Geology." Eleven editions of this work have been published, the last in 1872. In 1836–37, Lyell was chosen President of the Geological Society. A few years later, 1841–42, he visited the United States for geological observations; and again for social as well as geological studies in 1845–46. Narratives of these visits were soon afterwards published by him. He was again made President of the Geological Society in 1850–51.

Notwithstanding Lyell's early and clear perception of true method in natural science, he was by no means free at first, nor for a long time, from surviving conceptions of scholastic speculation, especially in his treatment of the biological division of geology; and he shared in the reaction, which extended to nearly every department of thought, of the present century against the freedom of speculation in the eighteenth. Deference to the high authority of Linnæus and Cuvier in the systematic sciences of natural history made him accept, as warranted by their observations, the doctrine of the immutability of species, which as a positive doctrine they had really derived implicitly from the scholastic meaning of the term species. His opposition to the transmutation theory of Lamarck was distinguished, however, from that of most of its opponents by a fair and judicial consideration of the arguments. But real and positive evidence on this subject had during a half century slowly accumulated; and many merely negative facts, defaults of evidence, which had been positively construed in accordance with current scholastic conceptions, were giving place to facts of a Baconian force and validity; and Lyell was foremost among the opponents of the transmutation theory to appreciate their significance. His treatise on "The Geological Evidences of the Antiquity of Man, with Remarks on Theories of the Origin of Species by Variation," appeared in 1863, four years after the first edition of Darwin's "Origin of Species." Three years later, in 1866, in the tenth edition of his "Principles," a

complete revision of his discussion of the development theory, abandoning the positions he had previously held, removed from this, his master-piece, its sole blemish; and gave to it a logical completeness, and an entire accordance with the physical principles, the types of its method, which it had previously lacked. And thus it happened that Lyell was one of the few veterans in science who relinquished their earlier views in consequence of the arguments and the facts in Darwin's "Origin of Species," and in his treatise on "The Variation of Animals and Plants under Domestication."

Both the earlier and this later position of Sir Charles Lyell on the transmutation theory were consequences of worthy traits of mind and character. He was "in nothing too much;" was cautious from the conservatism of a Liberal, and was not conservative through any taint of servility. A liberal in politics and religion as well as in science, he was deeply interested in the political conditions and social characteristics of America, where during his two visits he won to him the attachment of many life-long friends. His wife, a lady of rare gifts, the daughter of a distinguished geologist, Mr. Leonard Horner, was the constant companion of Sir Charles Lyell in his travels and studies. Bereft two years before by the death of this devoted friend, he died on the 22d of last February at the age of seventy-seven. He was a native of Scotland, the eldest son of Charles Lyell, Esq., of Kinordy, County Forfar. He was graduated at Oxford in 1821, and was called to the bar. He was knighted in 1848, and created a baronet in 1864. His scholarly attainments and a judicial spirit of accuracy, the results of his training, conduced not less than his native sagacity, patience, and amiability, to win for him the illustrious place which his name will ever hold in the history of science.

Since the last Annual Meeting the Academy has received an accession of twenty-one new members: eight Fellows, five Associate Fellows, and eight Foreign Honorary Members.

The list of the Academy, including 195 Fellows, 91 Associate Fellows, 70 Foreign Honorary Members, is hereto added:—

LIST

OF THE FELLOWS AND FOREIGN HONORARY MEMBERS.

MAY 11, 1875.

FELLOWS.

(Number limited to two hundred.)

CLASS I. — *Mathematical and Physical Sciences.* — 64.

SECTION I. — 13.
Mathematics.

Ezekiel B. Elliott,	Washington.
William Ferrel,	Cambridge.
Benjamin A. Gould,	Cambridge.
Gustavus Hay,	Boston.
John B. Henck,	Boston.
Thomas Hill,	Portland.
Edward Pearce,	Providence.
Benjamin Peirce,	Cambridge.
James M. Peirce,	Cambridge.
John D. Runkle,	Boston.
Edwin P. Seaver,	Cambridge.
Joseph Winlock,	Cambridge.
Chauncey Wright,	Cambridge.

SECTION II. — 7.
Practical Astronomy and Geodesy.

J. Ingersoll Bowditch,	Boston.
Alvan Clark,	Cambridgeport.
Henry Mitchell,	Roxbury.
Robert Treat Paine,	Boston.
William A. Rogers,	Cambridge.
George M. Searle,	New York.
Henry L. Whiting,	Boston.

SECTION III. — 26.
Physics and Chemistry.

John Bacon,	Boston.
John H. Blake,	Boston.
Thos. Edwards Clark,	Williamstown.
W. J. Clark,	Amherst.
Josiah P. Cooke, Jr.,	Cambridge.
James M. Crafts,	Boston.
William P. Dexter,	Roxbury.
Charles W. Eliot,	Cambridge.
Moses G. Farmer,	Newport.
Wolcott Gibbs,	Boston.
Augustus A. Hayes,	Brookline.
Henry B. Hill,	Cambridge.
Eben N. Horsford,	Cambridge.
T. Sterry Hunt,	Boston.
Charles L. Jackson,	Cambridge.
Joseph Lovering,	Cambridge.
John M. Merrick,	Boston.
William R. Nichols,	Boston.
John M. Ordway,	Boston.
Edward C. Pickering,	Boston.
Edward S. Ritchie,	Boston.
S. P. Sharples,	Cambridge.
Frank H. Storer,	Jamaica Plain.
John Trowbridge,	Cambridge.
Cyrus M. Warren,	Boston.
Charles H. Wing,	Boston.

SECTION IV. — 18.
Technology and Engineering.

H. L. Abbot,	New York.
G. R. Baldwin,	Quebec.
John M. Batchelder,	Cambridge.
C. O. Boutelle,	Washington.
Edward C. Cabot,	Boston.
Henry L. Eustis,	Cambridge.
James B. Francis,	Lowell.
John C. Lee,	Salem.
William R. Lee,	Roxbury.
Alfred P. Rockwell,	Boston.
John Rodgers,	Washington.
Stephen P. Ruggles,	Boston.
Charles S. Storrow,	Boston.
William H. Swift,	Boston.
John H. Temple,	W. Roxbury.
William R. Ware,	Boston.
William Watson,	Boston.
Morrill Wyman,	Cambridge.

CLASS II. — *Natural and Physiological Sciences.* — 64.

SECTION I. — 12.

Geology, Mineralogy, and Physics of the Globe.

Thomas T. Bouvé,	Boston.
William T. Brigham,	Boston.
Algernon Coolidge,	Boston.
John L. Hayes,	Cambridge.
Charles T. Jackson,	Boston.
Jules Marcou,	Cambridge.
William H. Pettee,	Cambridge.
Raphael Pumpelly,	Newburgh.
William B. Rogers,	Boston.
Nathaniel S. Shaler,	Cambridge.
Charles U. Shepard,	Amherst.
Josiah D. Whitney,	Cambridge.

SECTION II. — 10.

Botany.

Jacob Bigelow,	Boston.
George B. Emerson,	Boston.
William G. Farlow,	Cambridge.
George L. Goodale,	Cambridge.
Asa Gray,	Cambridge.
H. H. Hunnewell,	Wellesley.
John A. Lowell,	Boston.
Chas. J. Sprague,	Boston.
Edward Tuckerman,	Amherst.
Sereno Watson,	Cambridge.

SECTION III. — 24.

Zoölogy and Physiology.

Alex. E. R. Agassiz,	Cambridge.
J. A. Allen,	Cambridge.
Robert Amory,	Brookline.
Nath. E. Atwood,	Provincetown.
James M. Barnard,	Boston.
Thomas M. Brewer,	Boston.
Samuel Cabot,	Boston.
John Dean,	Waltham.
Silas Durkee,	Boston.
Herrmann A. Hagen,	Cambridge.
Alpheus Hyatt,	Cambridge.
Samuel Kneeland,	Boston.
Wm. James,	Cambridge.
Theodore Lyman,	Boston.
John McCrady,	Cambridge.
Edward S. Morse,	Salem.
Alpheus S. Packard, Jr.,	Salem.
Charles Pickering,	Boston.
L. Francis Pourtales,	Cambridge.
Frederic W. Putnam,	Salem.
Samuel H. Scudder,	Cambridge.
D. Humphreys Storer,	Boston.
Henry Wheatland,	Salem.
James C. White,	Boston.

SECTION IV. — 18.

Medicine and Surgery.

Samuel L. Abbot,	Boston.
Henry J. Bigelow,	Boston.
Henry I. Bowditch,	Boston.
Henry P. Bowditch,	Boston.
Edward H. Clarke,	Boston.
Benjamin E. Cotting,	Roxbury.
Calvin Ellis,	Boston.
Richard M. Hodges,	Boston.
Oliver W. Holmes,	Boston.
R. W. Hooper,	Boston.
John B. S. Jackson,	Boston.
Edward Jarvis,	Dorchester.
Edward Reynolds,	Boston.
Horatio R. Storer,	Boston.
John E. Tyler,	Boston.
J. Baxter Upham,	Boston.
Charles E. Ware,	Boston.
Henry W. Williams,	Boston.

Class III. — *Moral and Political Sciences.* — 67.

Section I. — 22.

Philosophy and Jurisprudence.

George Bemis,	Boston.
George T. Bigelow,	Boston.
Francis Bowen,	Cambridge.
John Henry Clifford,	New Bedford.
Richard H. Dana, Jr.,	Boston.
C. C. Everett,	Cambridge.
Horace Gray,	Boston.
Nich. St. John Green,	Cambridge.
Frederic H. Hedge,	Cambridge.
L. P. Hickok,	Northampton.
Ebenezer R. Hoar,	Concord.
Nathaniel Holmes,	St. Louis.
Mark Hopkins,	Williamstown.
C. C. Langdell,	Cambridge.
Henry W. Paine,	Cambridge.
Joel Parker,	Cambridge.
Theophilus Parsons,	Cambridge.
Charles S. Peirce,	Washington.
William A. Stearns,	Amherst.
Benjamin F. Thomas,	Boston.
Emory Washburn,	Cambridge.
Francis Wharton,	Cambridge.

Section II. — 12.

Philology and Archæology.

Ezra Abbot,	Cambridge.
William P. Atkinson,	Boston.
H. G. Denny,	Boston.
Epes S. Dixwell,	Cambridge.
William Everett,	Cambridge.
William W. Goodwin,	Cambridge.
J. B. Greenough,	Cambridge.
Ephraim W. Gurney,	Cambridge.
Horatio B. Hackett,	Newton Centre.
Chandler Robbins,	Boston.
E. A. Sophocles,	Cambridge.
Edward J. Young,	Cambridge.

Section III. — 16.

Political Economy and History.

Chas. F. Adams, Jr.,	Quincy.
Erastus B. Bigelow,	Boston.
Caleb Cushing,	Newburyport.
Charles Deane,	Cambridge.
Charles F. Dunbar,	Cambridge.
Samuel Eliot,	Boston.
George E. Ellis,	Boston.
William Gray,	Boston.
Edward Everett Hale,	Boston.
J. L. Motley,	Boston.
Francis Parkman,	Brookline.
A. P. Peabody,	Cambridge.
Edmund Quincy,	Dedham.
Nathaniel Thayer,	Boston.
Henry W. Torrey,	Cambridge.
Robert C. Winthrop,	Boston.

Section IV. — 17.

Literature and the Fine Arts.

Charles F. Adams,	Boston.
William T. Andrews,	Boston.
George S. Boutwell,	Groton.
J. Elliot Cabot,	Brookline.
Francis J. Child,	Cambridge.
Ralph Waldo Emerson,	Concord.
John C. Gray,	Cambridge.
Richard S Greenough,	Newport.
George S. Hillard,	Boston.
Henry W. Longfellow,	Cambridge.
James Russell Lowell,	Cambridge.
Charles Eliot Norton,	Cambridge.
John K. Paine,	Cambridge.
Thomas W. Parsons,	Boston.
Charles C. Perkins,	Boston.
John G. Whittier,	Amesbury.
Edward Wigglesworth,	Boston.

ASSOCIATE FELLOWS.

(Number limited to one hundred.)

Class I.—*Mathematical and Physical Sciences.*—33.

Section I.—7.

Mathematics.

Charles Avery,	Clinton, N.Y.
Alexis Caswell,	Providence, R.I.
Charles Davies,	New York.
Simon Newcomb,	Washington, D.C.
H. A. Newton,	New Haven, Conn.
James E. Oliver,	Ithaca, N.Y.
Truman H. Safford,	Chicago, Ill.

Section II.—12.

Practical Astronomy and Geodesy.

S. Alexander,	Princeton, N.J.
W.H.C. Bartlett,	West Point, N.Y.
J. H. C. Coffin,	Washington, D.C.
Chas. H. Davis,	Washington, D.C.
Wm. H. Emory,	Washington, D.C.
J. E. Hilgard,	Washington, D.C.
George W. Hill,	Nyack, N.Y.
Elias Loomis,	New Haven, Conn.
Maria Mitchell,	Poughkeepsie, N.Y.
C. H. F. Peters,	Clinton, N.Y.
Charles Wilkes,	Washington, D.C.
Chas. A. Young,	Hanover, N.H.

Section III.—10.

Physics and Chemistry.

F. A. P. Barnard,	New York.
John W. Draper,	New York.
Joseph Henry,	Washington, D.C.
John Le Conte,	San Francisco, Cal.
S. W. Johnson,	New Haven, Conn.
W. A. Norton,	New Haven, Conn.
Ogden N. Rood,	New York.
L.M. Rutherfurd,	New York.
Benj. Silliman,	New Haven, Conn.
J. L. Smith,	Louisville, Ky.

Section IV.—4.

Technology and Engineering.

R. Delafield,	Washington, D.C.
A.A.Humphreys,	Washington, D.C.
George Talcott,	Albany, N.Y.
W.P.Trowbridge,	New Haven, Conn.

Class II.—*Natural and Physiological Sciences.*—29.

Section I.—13.

Geology, Mineralogy, and Physics of the Globe.

George J. Brush,	New Haven, Conn.
James D. Dana,	New Haven, Conn.
J. W. Dawson,	Montreal, Canada.
Edward Desor,	Neufchâtel, Switz.
J. C. Fremont,	New York.
Arnold Guyot,	Princeton, N.J.
James Hall,	Albany, N.Y.
F. S. Holmes,	Charleston, S.C.
J. Peter Lesley,	Philadelphia.
Sir W. E. Logan,	Montreal, Canada.
Fred. B. Meek,	Washington, D.C.
Wm. T. Roepper,	Bethlehem, Pa.
Geo. C. Swallow,	Columbia, Mo.

SECTION II. — 4.

Botany.

A. W. Chapman,	Apalachicola, Fla.
G. Engelmann,	St. Louis, Mo.
S. T. Olney,	Providence, R.I.
Leo Lesquereux,	Columbus, Ohio.

SECTION III. — 8.

Zoölogy and Physiology.

S. F. Baird,	Washington, D.C.
C. E. Brown-Séquard,	New York.
J. C. Dalton,	New York.
J. P. Kirtland,	Cleveland, Ohio.
J. L. LeConte,	Philadelphia.
Joseph Leidy,	Philadelphia.
S. Weir Mitchell,	Philadelphia.
St. John Ravenel,	Charleston, S.C.

SECTION IV. — 4.

Medicine and Surgery.

W. A. Hammond,	New York.
Isaac Hays,	Philadelphia.
Wm. Sweetser,	New York.
George B. Wood,	Philadelphia.

CLASS III. — *Moral and Political Sciences.* — 29.

SECTION I. — 7.

Philosophy and Jurisprudence.

Horace Binney,	Philadelphia.
D. R. Goodwin,	Philadelphia.
R. G. Hazard,	Peacedale, R.I.
James McCosh,	Princeton.
Noah Porter,	New Haven, Conn.
Isaac Ray,	Philadelphia.
Jeremiah Smith,	Dover, N.H.

SECTION II. — 11.

Philology and Archæology.

S. P. Andrews,	New York.
A. N. Arnold,	Hamilton, N.Y.
S. S. Haldeman,	Columbia, Pa.
A. C. Kendrick,	Rochester, N.Y.
Geo. P. Marsh,	Rome.
L. H. Morgan,	Rochester, N.Y.
A. S. Packard,	Brunswick, Me.
E. E. Salisbury,	New Haven, Conn.
A. D. White,	Ithaca, N.Y.
W. D. Whitney,	New Haven, Conn.
T. D. Woolsey,	New Haven, Conn.

SECTION III. — 7.

Political Economy and History.

S. G. Arnold,	Newport, R.I.
Geo. Bancroft,	New York.
S. G. Brown,	Clinton, N.Y.
Henry C. Carey,	Philadelphia.
Henry C. Lea,	Philadelphia.
Barnas Sears,	Scranton, Va.
J. H. Trumbull,	Hartford.

SECTION IV. — 4.

Literature and the Fine Arts.

James B. Angell,	Ann Arbor, Mich.
Wm. C. Bryant,	New York.
F. E. Church,	New York.
Wm. W. Story,	Rome.

FOREIGN HONORARY MEMBERS.

(Appointed as vacancies occur.)

Class I. — *Mathematical and Physical Sciences.* — 25.

Section I. — 8.

Mathematics.

John C. Adams,	Cambridge.
George B. Airy,	Greenwich.
Brioschi,	Milan.
Arthur Cayley,	London.
Chasles,	Paris.
Le Verrier,	Paris.
Liouville,	Paris.
James Sylvester,	Woolwich.

Section II. — 4.

Practical Astronomy and Geodesy.

Döllen,	Pulkowa.
H. A. E. A. Faye,	Paris.
Peters,	Altona.
Otto Struve,	Pulkowa.

Section III. — 11.

Physics and Chemistry.

Bunsen,	Heidelberg.
Chevreul,	Paris.
Dumas,	Paris.
Helmholtz,	Berlin.
Kirchhoff,	Berlin.
J. C. Maxwell,	Cambridge.
J. C. Poggendorff,	Berlin.
Regnault,	Paris.
G. G. Stokes,	Cambridge.
Sir Chas. Wheatstone,	London.
Wöhler,	Göttingen.

Section IV. — 2.

Technology and Engineering.

Clausius,	Bonn.
Sir Wm. Thomson,	Glasgow.

Class II. — *Natural and Physiological Sciences.* — 25.

Section I. — 7.

Geology, Mineralogy, and Physics of the Globe.

Barrande,	Prague.
Charles Darwin,	London.
Dove,	Berlin.
James Prescott Joule,	Manchester.
W. H. Miller,	Cambridge.
Rammelsberg,	Berlin.
Sir Edward Sabine,	London.

Section II. — 7.

Botany.

George Bentham,	London.
Alexander Braun,	Berlin.
Decaisne,	Paris.
Alphonse de Candolle,	Geneva.
Elias Fries,	Upsal.
Hofmeister,	Tübingen.
Joseph Dalton Hooker,	London.

Section III. — 8.

Zoölogy and Physiology.

Von Baer,	St. Petersburg.
T. L. W. Bischoff,	Munich.
Ehrenberg,	Berlin.
Milne-Edwards,	Paris.
Albrecht Kölliker,	Würzburg.
Richard Owen,	London.
C. Th. Von Siebold,	Munich.
Valentin,	Berne.

Section IV. — 3.

Medicine and Surgery.

Andral,	Paris.
Rokitansky,	Vienna.
Virchow,	Berlin.

Class III. — *Moral and Political Sciences.* — 20.

Section I. — 4.

Philosophy and Jurisprudence.

T. C. Bluntschli,	Heidelberg.
Sumner Maine,	London.
James Martineau,	London.
De Rémusat,	Paris.

Section II. — 8.

Philology and Archæology.

Eyries,	Paris.
Pascual de Gayangos,	Madrid.
Benjamin Jowett,	Oxford.
Christian Lassen,	Bonn.
Lepsius,	Berlin.
Max Müller,	Oxford.
F. Ritschl,	Bonn.
Duke di Serradifalco,	Palermo.

Section III. — 5.

Political Economy and History.

W. Ewart Gladstone,	London.
Charles Merivale,	Oxford.
Mommsen,	Berlin.
Von Ranke,	Berlin.
Thiers,	Paris.

Section IV. — 3.

Literature and the Fine Arts.

Gino Capponi,	Italy.
Gérôme,	Paris.
J. J. da Costa de Macedo,	Lisbon.

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Cambridge: Press of John Wilson & Son.